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Global Ground Truth Data Set with Waveform and Arrival Data

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14. ABSTRACT

We present the final results of our three-year research project to produce a high-confidence global GT5 data set. During the course of this project we have developed, tested, and validated the hybrid HDC-RCA (Hypocentroidal Decomposition and Reciprocal Cluster Analysis) methodology to produce new GT5 or better event locations from event clusters. The HDC algorithm uses regional and teleseismic data to estimate precise relative event locations with respect to the cluster centroid. The RCA algorithm uses local data to precisely locate the cluster centroid. We have demonstrated that the HDC-RCA multiple event location methodology is able to produce high-confidence GT5 (epicenter and depth) or better event locations using only a few local stations, without reliance on independent GT information. A posteriori assessment procedures and a priori applicability criteria have been developed and tested to assure the quality and high-confidence of the resulting GT5 events. We have developed a novel, adaptive approach to waveform cross-correlation for improved differential arrival time measurements. The method finds the optimal time-bandwidth product to perform waveform cross-correlation, thus maximizing the similarity between waveforms for a wide range of seismic phases. Correlations are accepted or rejected based on their significance level derived from the estimated time-bandwidth product. We have further developed an error model to estimate the a priori uncertainties in differential time measurements in order to facilitate their inclusion with bulletin arrival time picks in the HDC algorithm. We demonstrated differential times contribute to significant improvements in resolving the relative event locations in the HDC analysis and validated the cross-correlation differential time measurement model. We have processed some 90 event clusters from all over the world, producing over 2,200 GT5 or better event locations at a high confidence level. The data set provides GT5 clusters in areas of the world previously devoid of GT5 reference events.

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Ground Truth, Location method, Waveform correlation

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1. INTRODUCTION

The objective of this research was to produce new ground truth events with 5 km location accuracy (GT5) or better at a high confidence level on a global scale. Accurate seismic event locations are necessary to develop and validate improved velocity models and perform calibration studies. Recognizing the need for high quality reference events, the recent years saw a concentrated effort to develop methodologies to identify and validate ground truth event locations. Most of these methods rely on either dense local networks (e.g. Bondár et al, 2004a; Bondár et al, 2004b; Richards et al, 2006), or independent (non-seismic) GT information (e.g. Fisk, 2002; Parsons et al., 2006; Waldhauser and Richards, 2004; Walker et al., 2005). Our motivation was to develop a methodology that allows us to identify GT5 or better events without the reliance upon dense local networks or prior GT information.

We have developed and validated a hybrid multiple event technique that is able to produce GT5 events from a cluster of earthquakes using just a few local stations. In the two-tier HDC-RCRA method we employ Hypocentroidal Decomposition (HDC, Jordan and Sverdrup, 1981; Bergman and Engdahl, 2007), a multiple event location technique that uses regional and teleseismic data to estimate precise relative event locations with respect to the cluster hypocentroid. Then, by using local data along with a local velocity model we eliminate the regional/teleseismic location bias due to velocity heterogeneities unaccounted for by the global 1D ak135 (Kennett et al., 1995) velocity model used in HDC. To do this, we perform Reciprocal Cluster Analysis (RCA, Bondár et al, 2005, 2006, 2007a, 2007b) which by fixing the event pattern and using the events as fictitious stations locates the station centroid. The entire cluster is then shifted so that the true and apparent station centroids coincide. Hence, RCA determines the necessary shift for the cluster hypocentroid to obtain accurate absolute event locations. Invoking the reciprocity principle allows us to use just a few stations; in the extreme case RCA may work with a single station inside the event cluster. Since the station locations are exactly known, the station centroid provides a GT0 constraint, thus eliminating the need for prior GT information.

We have developed a novel approach to waveform cross-correlation for improved differential arrival time measurements. Our method finds the optimal time-bandwidth product to perform waveform cross-correlation, thus maximizing the similarity between waveforms for a wide range of seismic phases. Correlations are accepted or rejected based on their significance level derived from the estimated time-bandwidth product. We have further developed an error model to estimate the *a priori* uncertainties in differential time measurements in order to facilitate their inclusion with bulletin arrival time picks in the HDC algorithm. We have demonstrated that even a small proportion of differential times contribute to significant improvements in resolving the relative event locations.

We have processed 86 event clusters with the HDC-RCA analysis. Most of the clusters were extracted from an updated EHB (Engdahl et al., 1998) bulletin, and in a few cases we have also used local data (e.g. aftershock deployments) not reported to the ISC.

We primarily focused on areas with sparse local networks where the HDC-RCA methodology shows its real strength compared to other multiple event location methods. Our objective was to achieve a balanced global coverage of GT5 or better events. From the total of 86 event clusters 66 clusters produced altogether 2,279 GT5 or better events.

2. BACKGROUND

Accurate seismic event locations are necessary to develop and validate improved velocity models and perform location calibration studies. If the event locations are biased, the products (velocity models, travel-time predictions) will also be biased. Since the main objective of earthquake catalogues is to achieve completeness down to the lowest magnitude levels, published bulletins contain a mixture of accurate, good and poor locations. Thus, event locations in earthquake catalogues should always be treated with caution. To identify accurately located events at a high confidence level in published bulletins, Bondár et al (2004a) developed GT selection criteria that are based on the network geometry. However, for events at the GT5 level these criteria require a dense local network with a good azimuthal coverage. Therefore the existence of dense local networks limits the applicability of the Bondár et al (2004a) GT selection criteria.

Multiple event location methods are proven techniques to obtain relative locations in an event cluster. Most multiple event location techniques use differential arrival time data to estimate relative locations within a cluster of events. Double-difference algorithms (e.g. Got et al, 1994; Waldhauser and Ellsworth, 2000; Zhang and Thurber, 2003) have been written to explicitly utilize differential travel time data, while Hypocentroidal Decomposition algorithms (Jordan and Sverdrup, 1981; Bergman and Engdahl, 2007) use absolute arrival time picks as input and calculate differential times internally. These methods do not solve for the source-receiver path anomalies but project them into the null space. Wolfe (2002) shows that under sufficiently constrained circumstances the double-difference and HDC algorithms are equivalent to each other. While both methods provide accurate relative locations, neither of them could perfectly resolve absolute event locations without dense local station coverage.

In order to get absolute locations, modern multiple event location techniques utilize independent GT information, such as existing reference events (e.g. Ritzwoller et al., 2003; Bondár et al., 2004b), seafloor bathymetry (Pan et al., 2002), satellite imagery (e.g. Fisk, 2002), InSAR interferometry (e.g. Biggs et al., 2006; Parsons et al, 2006) and active fault lines (Waldhauser and Richards, 2004) to estimate the mislocation vector between the true and apparent cluster hypocentroid. Hence, the availability of prior accurate independent GT information limits the applicability of multiple event location methods.

Our motivation was to develop a multiple event location technique that provides accurate relative and absolute locations, without reliance upon independent GT information or upon dense local networks.

Waveform cross-correlation techniques are widely used in event identification (e.g. Israelsson, 1990; Harris, 1991), detection (e.g. Gibbons and Ringdal, 2006; Gibbons et

al., 2007) and location (e.g. Shearer, 1997; Waldhauser and Ellsworth, 2000; Zhang and Thurber, 2003; Schaff and Richards, 2004; Massa et al., 2006; Richards et al, 2006). In recent years waveform cross-correlation has become a standard technique to obtain consistent sets of differential times. The accuracy of relative delay times obtained from waveform cross-correlation is invariably superior to analyst picks. Poupinet et al. (1984) have shown that subsample precision can be achieved.

Our challenge was to extend waveform correlation processing to a wide variety of signal bandwidths, durations and instrument types.

3. TECHNICAL APPROACH

3.1 HDC-RCA method

Reciprocal Cluster Analysis (RCA) is a multiple event location technique that combines local data with regional/teleseismic HDC results to obtain accurate absolute event locations using the local stations as GT0 constraints. In the followings we describe the procedures to form event clusters for the HDC-RCA analysis, present the RCA algorithm, and identify under what the conditions HDC-RCA can be expected to produce GT5 events at a high confidence level.

3.1.1 HDC-RCA procedures

We typically extract event clusters from an updated EHB (Engdahl et al, 1998) bulletin which spans four decades of groomed International Seismological Centre (ISC, 2001) bulletins. We seek localities where a number of moderate-size, shallow (crustal) earthquakes are spatially clustered (with about 50-100 km cluster diameter) and a subset of events has been recorded by local stations. Note that the latter is the stronger constraint as in many regions of the world local networks have been deployed only recently. Hence, while we can use the entire span of the EHB bulletin to build an HDC cluster, the subset of locally recorded events in these regions is restricted to more recent events. While in many cases the clusters are formed from aftershock sequences, the events in the cluster may actually be widely distributed in time, as long as arrival time data at common stations are available.

Multiple event location techniques implicitly rely on the assumption that the events in a cluster and the stations used in the inversion are well-connected, i.e., stations observed many events in the cluster. To assess cluster connectivity, we employ a graph theoretical approach. An event cluster can be viewed as an undirected graph, where the vertices are the events and stations, and the edges are the ray paths (arrivals). An undirected graph is biconnected if at least two different paths exist between any two vertices (Orwant et al., 1999). Therefore, when biconnectivity holds in an event cluster, all stations detected at least two events and all events are recorded by at least two stations. Biconnectivity ensures that there are neither isolated vertices in the graph, nor bridges whose removal would cause the graph to fall into disconnected pieces. To build a cluster for HDC analysis, we extract the largest biconnected graph from the initial EHB event cluster. The

HDC procedures may discard arrivals or entire events based on outlier analysis. Similarly, for the RCA cluster we extract the largest biconnected graph from the HDC output for stations in the 0-1.5° distance range, and as an additional constraint we require that each station record at least three events. The choice for the RCA distance range is motivated by the desire to select truly local phases (Pg, Sg, Pb, Sb) and avoid phase identification problems in the Pg/Pn cross over distance range.

The HDC algorithm is described in details in Jordan and Sverdrup (1981) and Bergman and Engdahl (2007). The HDC method separates the multiple event location problem into the estimation of the relative event locations in the cluster (relative to the hypocentroid), and the location of the hypocentroid itself. The two-step process is repeated iteratively until convergence is reached. The cluster hypocentroid is located in an absolute sense, as if all the data were from a single event, using the global 1D ak135 model (Kennett et al., 1995). Hence the cluster hypocentroid is biased due to unmodeled velocity heterogeneities in the Earth.

3.1.2 Reciprocal Cluster Analysis

While in this study HDC uses stations in the 3-90° distance range when locating the hypocentroid, RCA utilizes stations within 0-1.5° from the hypocentroid, thus introducing new information. In the RCA inversion we fix the *pattern* of relative hypocenters and origin times obtained from HDC, and locate the centroid of the local seismic stations, using the relative event locations as fixed fictitious stations. We also use a local velocity model when available to obtain travel time predictions for local phases.

The RCA concept is envisioned as if the local station network and the event cluster were two rigid meshes. One mesh is fixed; the other mesh is allowed to move but only as a rigid entity. The connectivity between two rigid bodies is provided by the arrivals between event-station pairs; these could be imagined as coil springs. The force along each spring is proportional to the weighted travel-time residual with respect to the local velocity model. If the system is not in equilibrium (i.e. the event locations are biased) the resulting force will pull the free mesh to the position that minimizes the energy of the system. Obviously, the better connected the meshes are, the less prone the system is to outliers. The amount by which the center of gravity of the free mesh moves is equal to the bias in HDC locations. Note that in this representation it is irrelevant which mesh is fixed and which one is free. Therefore, locating the local station network centroid is equivalent to locating the hypocentroid of the cluster. In our implementation we solve for the station centroid that represents a GT0 constraint.

Since we treat the cluster of events and the station network as two separate rigid bodies, the ‘forces’ acting on the source-receiver pairs affect the entire rigid body of the free mesh. Therefore, the multiple event location system of equations, which in our case would typically pose an underdetermined inversion problem due to the low number of observations relative to the number of model parameters, simplifies to solving for the station centroid when the rigid body constraints are added. As the number of model parameters reduces to four, the system of equations now represents an overdetermined inversion problem that is robust with respect to strong local seismic velocity biases.

Let's assume that there are k = 1..*K* local stations and *i* = 1..*N* events in a cluster of events. Each event has M_i local observations which constitute $M = \sum_{i=1}^{N} M_i$ total number of observations. We allow the use of secondary phases in the RCA inversion, and a station does not necessarily record every event in the cluster. The residual of the j^{th} observation at the k^{th} station for the i^{th} event is then written as $d_{k_j i} = w_{k_j i}(T_{k_j i}^{obs} - T_{k_j i}^{pred})$ where $w_{k_j i}$ is 1 if the observation exists, 0 otherwise. The model parameters are the coordinates of the station centroid: $[\lambda_C, \varphi_C, z_C, \tau_C]^T$. We solve the system of linearized equations shown below by an iterative weighted least squares method.

$$\begin{bmatrix} \frac{\partial T_{1_1 1}}{\partial \lambda_1} & \frac{\partial T_{1_1 1}}{\partial \varphi_1} & \frac{\partial T_{1_1 1}}{\partial z_1} & 1 \\ \vdots & \vdots & \vdots & \vdots \\ \frac{\partial T_{1_j N}}{\partial \lambda_1} & \frac{\partial T_{1_j N}}{\partial \varphi_1} & \frac{\partial T_{1_j N}}{\partial z_1} & 1 \\ \vdots & \vdots & \vdots & \vdots \\ \frac{\partial T_{k_j i}}{\partial \lambda_k} & \frac{\partial T_{k_j i}}{\partial \varphi_k} & \frac{\partial T_{k_j i}}{\partial z_k} & 1 \\ \vdots & \vdots & \vdots & \vdots \\ \frac{\partial T_{K_J N}}{\partial \lambda_K} & \frac{\partial T_{K_J N}}{\partial \varphi_K} & \frac{\partial T_{K_J N}}{\partial z_K} & 1 \end{bmatrix} \begin{bmatrix} \Delta\lambda_C \\ \Delta\varphi_C \\ \Delta z_C \\ \Delta\tau_C \end{bmatrix} = \begin{bmatrix} d_{1_1 1} \\ \vdots \\ d_{1_j N} \\ \vdots \\ d_{k_j i} \\ \vdots \\ d_{K_J N} \end{bmatrix}$$

The size of the matrix of partial derivatives is *M*x*4*. Writing the system of equations in this way represents the underlying RCA concept of treating the stations and events as two separate rigid bodies that are only allowed to move relative to each other, without changing the pattern of events. The reciprocity principle is reflected in the fact that we evaluate the partial derivatives of the predicted travel times at the station locations (fictitious events). After each iteration the coordinates of the fictitious events are adjusted by the model adjustment vector.

In the inversion process the residuals are weighted by the *a priori* estimates of their uncertainties. Applying the reciprocity principle implies that due to the uncertainties in the relative event locations we do not know where exactly our fictitious stations are. To account for this extra error term we propagate the relative event location uncertainties into the RCA error budget as uncertainties in travel-time. This is achieved by multiplying the covariance matrices (Σ_i) describing the spatial and origin time uncertainties in the relative event locations by the predicted slowness vector ($s_{k_j i}$) for a particular observation: $\sigma^2_{k_j i,rel} = s^T_{k_j i} \Sigma_i s_{k_j i}$. Thus, readings for events with large relative uncertainties are down weighted in the RCA inversion. We assume 0.5 second reading error for local P phases, and 0.9 second RMS reading error for local S phases. The total *a priori*

uncertainty in a phase pick is then expressed by the sum of the measurement, model and relative location errors: $\sigma^2_{k_j i,total} = \sigma^2_{k_j i,meas} + \sigma^2_{k_j i,\mathrm{model}} + \sigma^2_{k_j i,rel}$.

Since regional and teleseismic data usually lack the resolution to resolve the full depth pattern in a cluster, event depths are typically fixed in the HDC analysis to a best educated guess, based on analysis of individual events with depth phases, waveform analyses, or prior local data. If there are no close-in stations to the centroid, RCA only solves for the horizontal shift of the cluster centroid (2 unknowns) by keeping the depths and origin times fixed to the HDC results, otherwise we solve for all model parameters (horizontal, vertical and origin time shifts). The RCA step is generally over determined (only 2 to 4 unknowns). It is imperative to use local velocity models, especially for the depth inversion.

Once a convergent solution is reached, the mislocation vector between the true (GT0) and apparent station centroids represents the bias in the HDC locations. The entire cluster (including events that did not take part in the RCA inversion) is then shifted so that the apparent and true station centroids coincide, thus yielding absolute event locations. Finally, the model covariance matrix of the station centroid, which represents the location uncertainties in the absolute hypocentroid location, is added to the covariance matrices of the relative event locations to obtain the absolute location uncertainties for each individual event in the cluster. The covariance matrices are scaled to the 95% confidence level and the 95% coverage error ellipses, depth and origin time errors are calculated. Events with semi-major axis less than 5 km are then promoted to GT5 status.

3.1.3 Validation tests

Since we promote locations to GT5 status based on the size of their absolute error ellipses, it is important that both the HDC relative error ellipses and the RCA absolute error ellipse on the centroid are reliable and provide the actual coverage claimed by their confidence level. We chose the Nevada Test Site (NTS) underground nuclear explosions to validate the HDC-RCA analysis. NTS offers an ideal data set for testing and validating new algorithms as there is an abundance of GT0 events, well-recorded at all distance ranges.

One of the fundamental assumptions in the RCA algorithm is that HDC accurately recovers the event pattern. To validate this assumption we performed HDC on the Pahute Mesa, NTS cluster of 52 GT0 events. HDC, using regional and teleseismic phases with ak135 (Kennett et al., 1995) travel-time tables, mislocated the event centroid by 12 km. Figure 1 illustrates that when the HDC bias is removed, the HDC event pattern (blue dots) matches the true event pattern (green dots) quite well and the HDC relative 90% confidence error ellipses provide almost 90% coverage as expected.

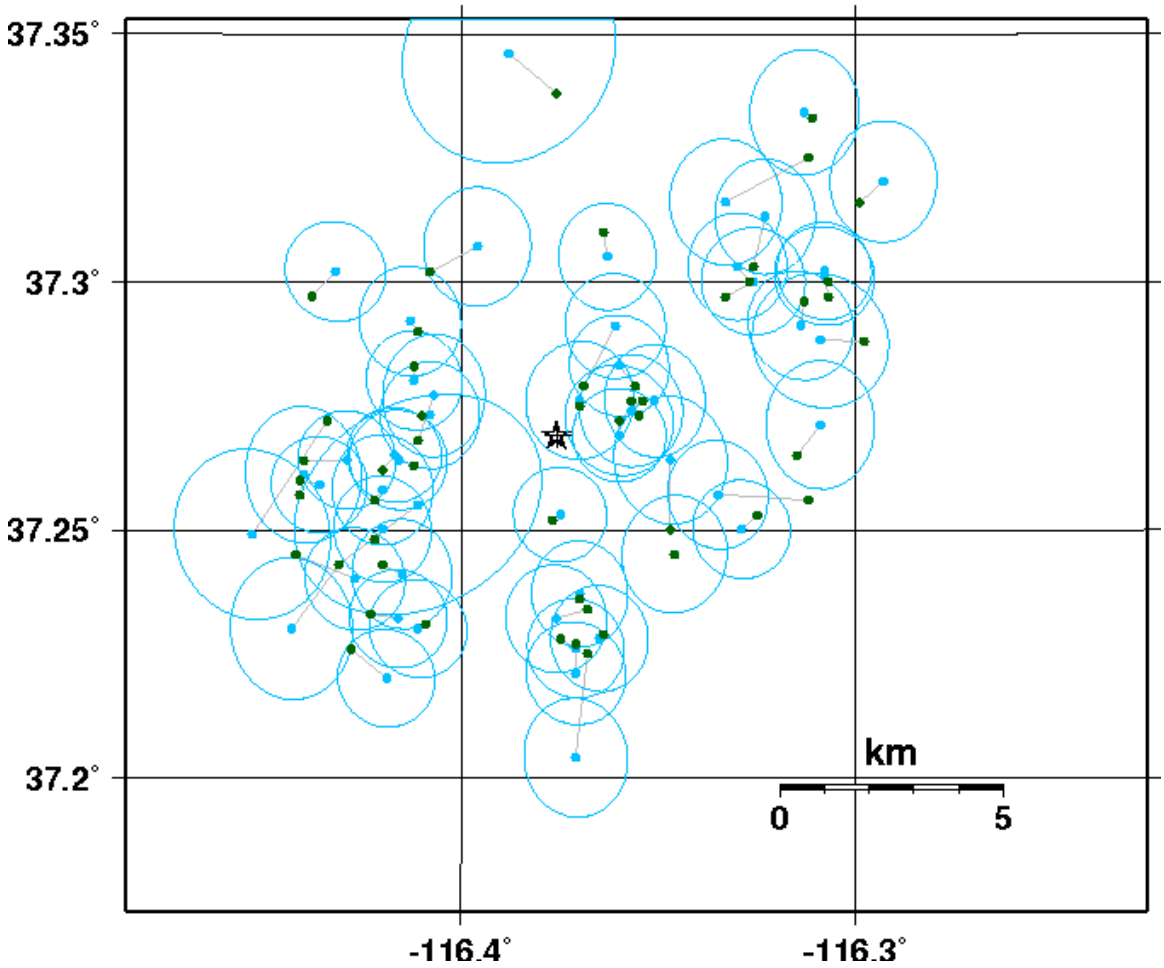

Figure 1. Pahute Mesa, NTS GT0 cluster. When the HDC location bias is removed, the HDC (blue) relative error ellipses cover 90% of the true (green) locations.

As we noted earlier, RCA eliminates the regional/teleseismic bias in the HDC hypocentroid. However, RCA is still prone to local bias due to unmodeled local velocity structure. We account for travel-time prediction errors inherent in a local velocity model by introducing generic, distance-dependent model errors, as plotted in Figure 2a. To validate that 1) the true event centroid is located within 5 km of the event centroid recovered by RCA, and 2) the RCA error ellipse covers the true centroid 95% of the time we again used the Pahute Mesa GT0 cluster. Since this time we are only interested in RCA performance and the effect of the local velocity model, we start from the true event pattern with no relative errors at all (i.e. we used the GT0 locations as the initial locations for RCA). We used the Western US velocity model by Ritsema and Lay (1995) and performed a bootstrapping RCA experiment by selecting near optimal subnetworks with increasing number of stations from the local network shown in Figure 2b.

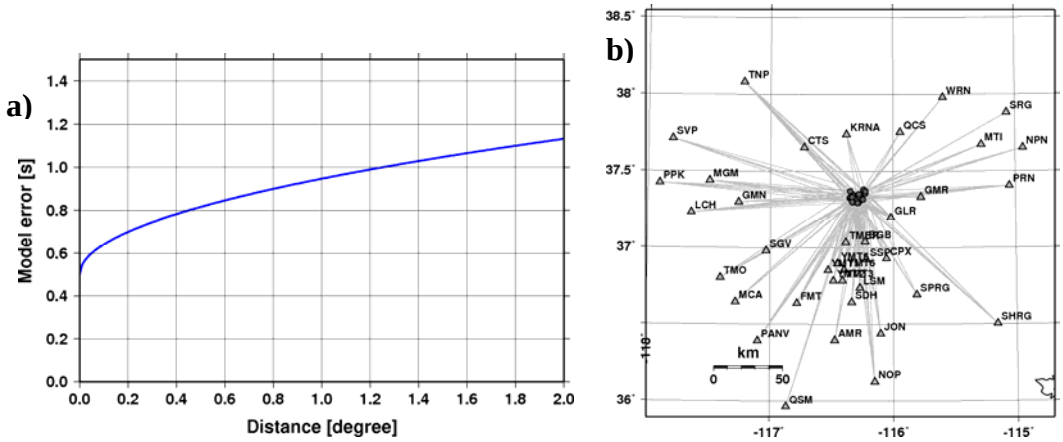

Figure 2. a) Distance dependent model error curve employed in RCA to account for local unmodeled travel-time prediction errors. b) Local network for the GT0 Pahute Mesa cluster used in subnetwork boostrap exercise.

The results are summarized in Figures 3 and 4. The local velocity model introduces a bias of about 2 km. While the event centroid mislocations are all less than 5 km (Figure 3), the introduction of local model errors is necessary to achieve 95% coverage (Figure 4). For the four cases where the centroid mislocation is larger than 5 km (orange dots in Figure 4) the semi-major axes of the 95% error ellipses is also larger than 5 km, thus the semi-major axes of the absolute error ellipses of the individual events would also be too large to promote any events to GT5 status. Green triangles denote the bootstrap realizations for which events would be promoted to GT5 status. Blue dots represent the cases of missed GT for which the location is well within 5km, but the error ellipse is too large to be identified as GT5. This is consistent with our conservative approach to minimize the number of false alarms. In other words, we would rather loose some GT5 events than promote non-GT events to GT5 status.

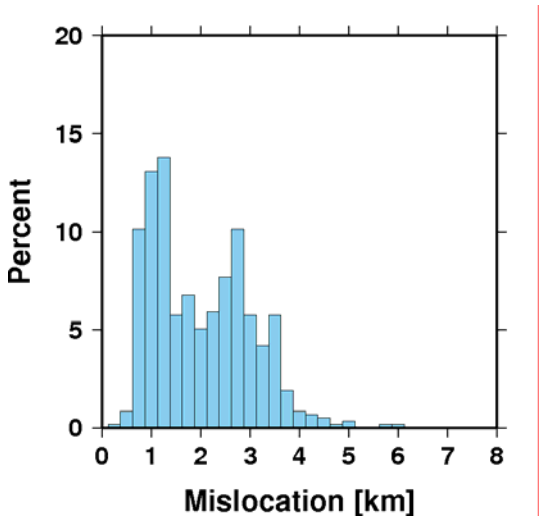

Figure 3. The event centroid recovered by RCA is within 5 km of the true location.

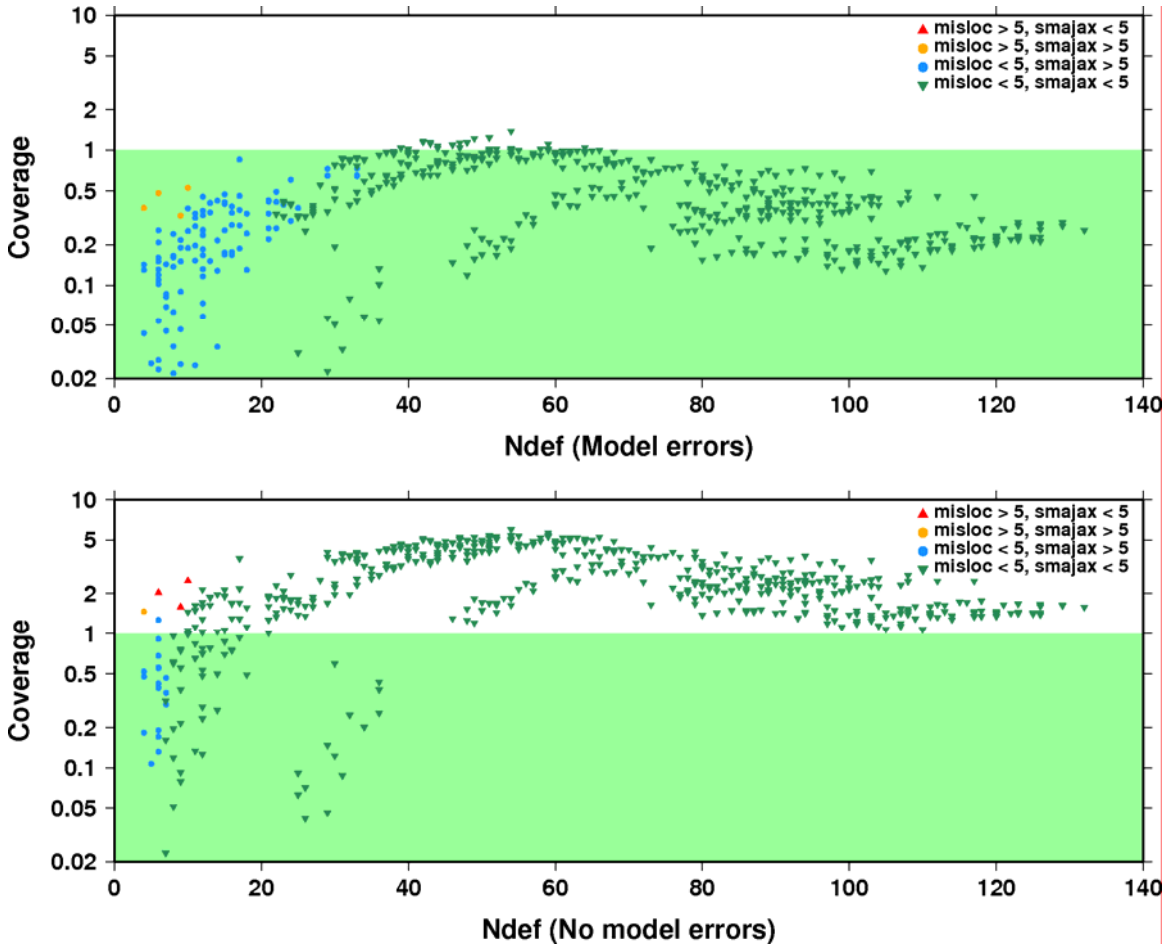

Figure 4. The RCA error ellipses provide 95% coverage when local velocity model errors are included.

Another assumption the RCA algorithm depends upon is that the observations are independent. With dense local networks, such as the one in Figure 5a, there is always a chance that similar ray paths produce similar travel-time prediction errors due to unaccounted local velocity heterogeneities. Thus, by ignoring the correlated error structure, the location uncertainties are underestimated. Indeed, when using the entire network in Figure 5a, Figure 6a shows that the stations south of the cluster conspire to pull the RCA centroid slightly to the southeast and the 95% absolute error ellipses (combined HDC and RCA location uncertainties) do not cover 95% of the true locations. However, when we use a subnetwork shown in Figure 5b with a still acceptable combined secondary azimuthal gap, the 95% error ellipses do cover GT0 locations (Figure 6b) because the network now better satisfies the assumption of independent errors.

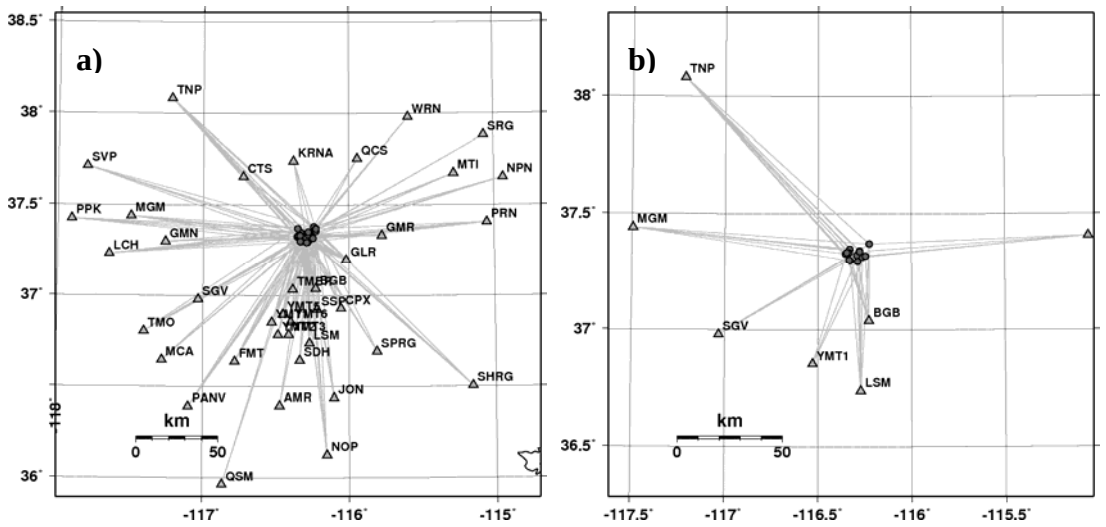

Figure 5. a) Local network for the GT0 Pahute Mesa cluster b) a 7-station subnetwork.

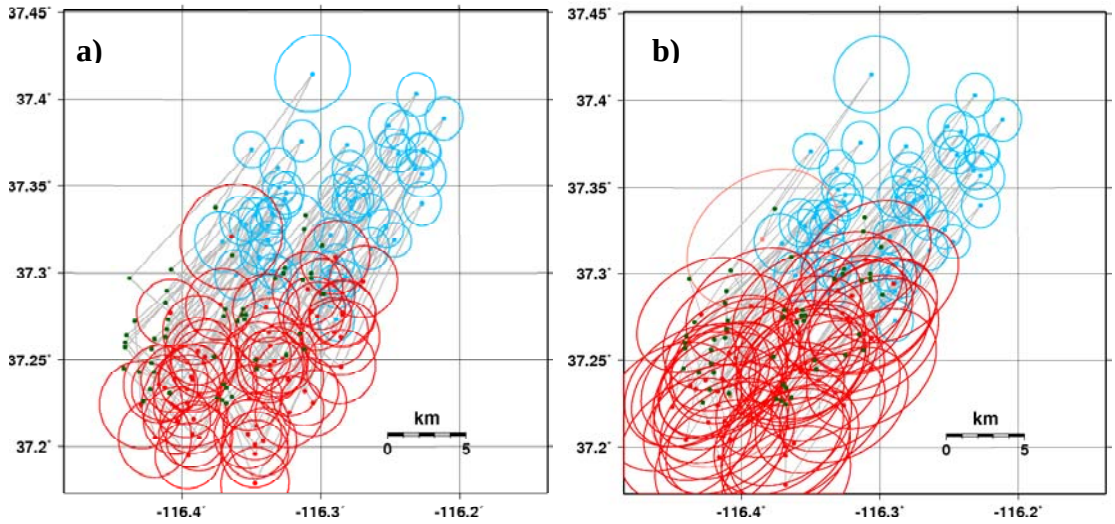

Figure 6 a) RCA results when using all stations in the local network shown in Figure 5a. Blue – HDC, red – RCA, green – GT0 locations. While the RCA event mislocations are about 3 km, the 95% error ellipses do not cover the GT0 locations. b) RCA results using the subnetwork in Figure 5b. The error ellipses now cover the true locations, and 50 out of 52 events are identified as GT5.

Figure 6 conveniently allows us to make another important point. Since not every station recorded every event, had we had only the sparse seven-station network, we could have only located four events with a conventional single event location algorithm. RCA, on the other hand, used 7 stations and 13 events to determine the HDC location bias which located all events within 5 km of GT0 and identifies 50 (out of 52) locations as GT5. Thus, in favorable conditions RCA may produce GT5 or better locations with sparse local networks.

3.1.4 Applicability criteria

One might ask the question under what conditions the HDC-RCA method may or may not produce GT5 events. To answer this question, we performed a Monte Carlo analysis on a synthetic event cluster. Our objective was to derive applicability criteria, similar to those developed by Bondár et al. (2004a) to identify GT5 event locations in published bulletins.

To generate the synthetic cluster we distributed Yucca Flat, Nevada Test Site, GT0 nuclear explosions along a provisional plane (Figure 7a), creating a synthetic cluster of events of GT0 accuracy in both location and depth. The arrival times are generated as iasp91 (Kennett and Engdahl, 1991) travel-time predictions at local (Pg), regional (Pn) and teleseismic (P) distances. We added distance- and azimuth-dependent delays to the arrival times to imitate separate local, regional, and teleseismic source-receiver path anomalies. We then relocated the events keeping the depths fixed and using Pn and P phases only, which resulted in a 12 km location bias. This constituted the synthetic input cluster for the RCA Monte Carlo experiment, where we used Pg arrivals only. The Pg travel time bias is about ±1 s over 150 km which is roughly equivalent to a ±5% velocity perturbation with respect to iasp91 (Figure 7b). The way we introduced the travel time biases represents a rather extreme scenario where even a perfectly balanced network would produce location bias with stations to the south being increasingly slow and increasingly fast to the north.

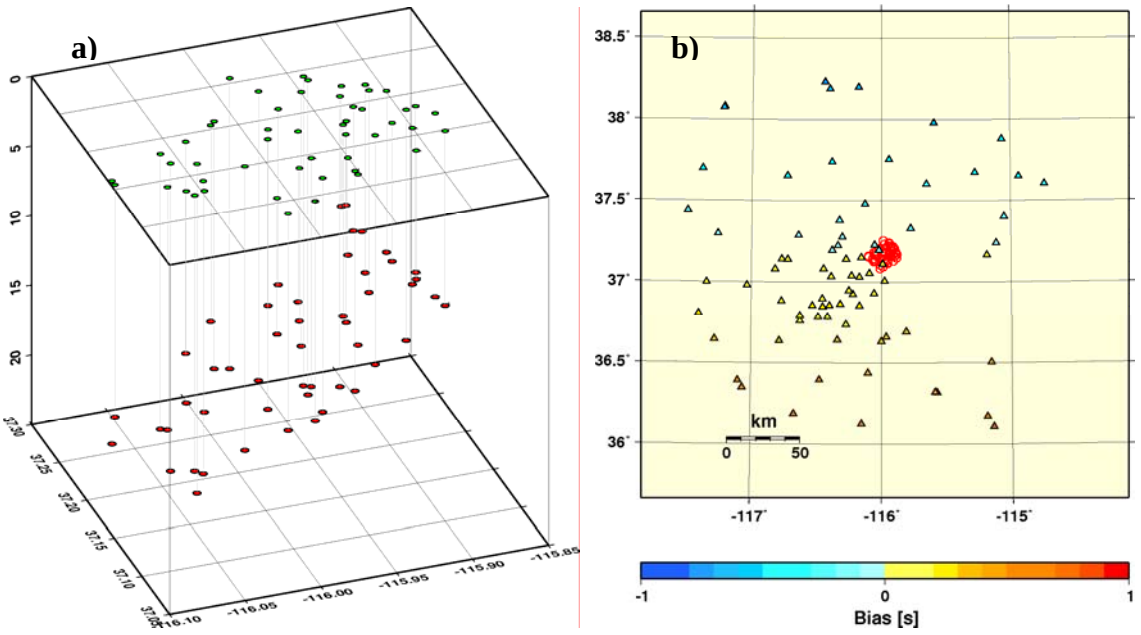

Figure 7 a) Synthetic cluster generated from Yucca Flat, NTS nuclear explosions. Events were randomly distributed along a plane (strike=45°, dip=45°), and arrival times were calculated using iasp91 predictions and distance and azimuth dependent delays. b) Local network configuration for the synthetic cluster. Due to the introduced Pg travel time bias, Pg arrival times at stations to the south are increasingly late and increasingly early to the north.

In the course of the Monte Carlo experiment we selected 5,000 realizations of random, biconnected clusters (subsets of events and stations) from the synthetic cluster. For each realization we performed RCA and generated various metrics to assess the quality of the RCA results. We found that the combined secondary azimuthal gap, defined as the largest secondary azimuthal gap when considering the azimuths of all event-station pairs, provides a robust metric to predict the location accuracy of the cluster centroid.

The lower panel in Figure 8 shows the cumulative distributions of the station centroid horizontal and vertical mislocation for combined secondary gaps less than a specific threshold. The figure suggests that we are able to recover the true cluster centroid within 5 km at the 90% confidence level when the combined secondary gap is less than 140°. However, this alone does not guarantee that the centroid depth is recovered with high accuracy. Not surprisingly, we need at least one station in the close vicinity of the cluster centroid to provide a constraint on the hypocentroid depth. This is illustrated in the middle panel of Figure 8. When there is at least one station within 30 km of the cluster centroid and the combined secondary gap is less than 140°, the epicenter of the cluster centroid is recovered within 5 km at the 95% confidence level, and the centroid depth is recovered within 5 km at the 90% confidence level. It is easy to show that the minimal RCA graph is defined by three events and two stations where both stations record all events, thus defining six event-station pairs, and in a perfectly symmetric arrangement, a 120° combined secondary azimuthal gap. However, this would hardly constitute an overdetermined inversion problem. As the upper panel of Figure 8 indicates, we need at least 25 event-station pairs to guarantee a robust solution.

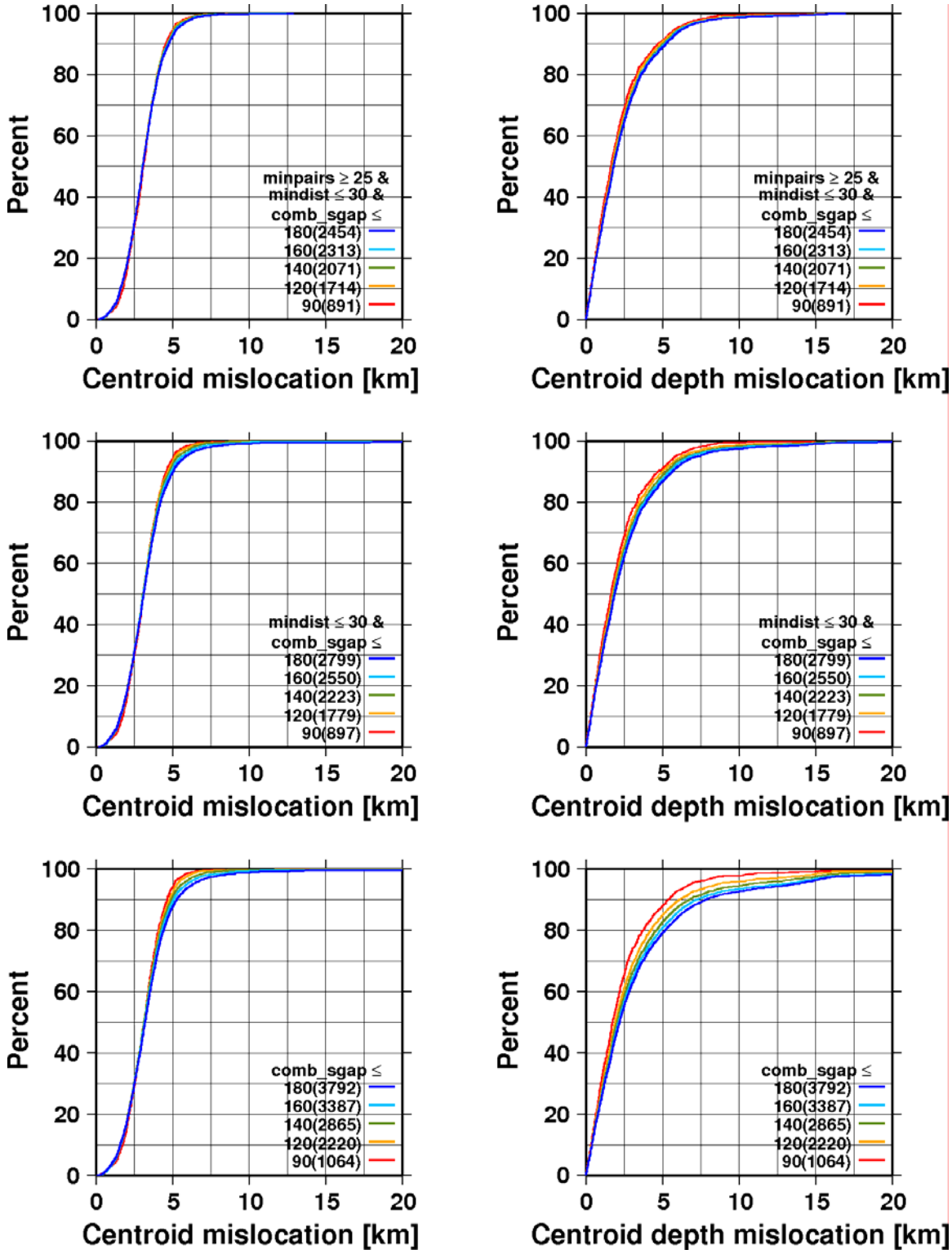

Figure 8. Cumulative distributions of the RCA station centroid horizontal and vertical mislocations in the Monte Carlo experiment with a synthetic cluster for combined secondary gaps less than 90°, 140° and 180° (lower panel), with at least one close-in station (middle panel) and at least 25 event-station pairs (upper panel).

The necessary conditions below provide GT5 applicability criteria for the cluster centroid, analogous to the GT5 criteria of Bondár et al. (2004a) for single-event locations.

- The combined secondary azimuthal gap is less than 140° and
- There are at least 25 station-event pairs.

The hypocentroid depth can only be resolved at a high confidence level if there are close-in stations in the cluster. If a cluster fails to satisfy the above criteria, we reject the entire cluster. We consider these criteria necessary (but not sufficient) conditions to generate GT5 events. Once the absolute location of the cluster centroid is pinned down with high accuracy, we promote events to GT5 category if the semi-major axis of their combined absolute error ellipses (HDC+RCA), scaled to the 95% confidence level, is less than 5 km. It should be noted that failing the GT5 applicability criteria does not mean that the locations are wrong; it only means that the cluster centroid cannot be recovered with GT5 accuracy at high confidence. In many cases the cluster centroid (and thus many of the events in the cluster) could still qualify for GT10.

3.2 Waveform correlation

Significant sources of uncertainty in HDC relative locations are arrival time measurement errors. Improvements in the HDC results may be obtained by using precise and accurate differential times from cross-correlations, either by picking the lag of the maximum from a time-domain correlation or by measuring the phase when using a cross-spectral approach (see Schaff et al., 2004 for a comparison of the techniques).

To apply the waveform cross-correlation methodology that has been very successful at local distances to regional and teleseismic data sets, we had to address several challenges. Central to exploiting the results of waveform cross-correlation is the selection of a correlation threshold. In most local applications (e.g. Schaff et al., 2004; Shearer, 1997; Thurber et al. 2003) a heuristic approach is used to select an operational correlation threshold that was then demonstrated to be fairly robust at screening out the less reliable differential measurements. The relative uniformity of these data sets (all simple local P arrivals, typically only involving single- or three-component short period data) allowed for the selection of a single uniform correlation threshold without adversely affecting the results. In our automated application, the regional and teleseismic recordings consisted of very diverse sets of stations, including single- and three-component stations as well as regional and teleseismic arrays. Data were collected from short period and broadband sensors with various responses and noise characteristics. Furthermore, regional and teleseismic recordings include a wide range of phase types (P, Pg, Pb, Pn, Sg, Sn) with varying signal bandwidths, durations and signal-to-noise ratios. In order to apply waveform correlation processing to a wide variety of signal bandwidths, durations and instrument types, we developed several novel solutions.

3.2.1 Significance of the maximum correlation coefficient

We perform waveform cross-correlation processing on the individual pairs of channels (resampled at 200 Hz) of arrays or three-component stations in the time domain and stack the correlation traces to improve the signal-to-noise ratio on the array-based correlation trace. Then, instead of setting an arbitrary threshold for the correlation coefficient, we measure the strength of correlation by its statistical significance. The significance of a correlation is defined as the significance level at which we can reject the hypothesis that we are correlating noise with noise in the measured time-bandwidth product (Bondár et al, 2006). This allows us to retain differential time measurements from correlation runs where the absolute correlation level might otherwise fall below the correlation threshold. In other words, a relatively low correlation may still be highly significant if the time-bandwidth product is large.

We measure the empirical time-bandwidth product following the methodology of Harris (1991). When cross-correlating noise or independent signals, Fisher's z-transform, defined as $z=\text{atanh}(r)$ (r being the correlation), follows an asymptotic normal distribution with zero mean and variance of $\sigma^2=1/(N-3)$. The maximum of z follows an extreme value distribution, whose cumulative distribution function gives us the expected probability at any given percentile level that we are correlating noise with noise:

$$F(\max(z)) = \left[\frac{1 + erf\left(\max(z)/\sqrt{2}\sigma\right)}{2} \right]^M$$

where M = 2 * ((target window length) – (template window length)) * ($f_{high} - f_{lo}$) is the number of independent measurements measured by sliding the template window along the target window where both traces are band-pass filtered between f_{high} and f_{lo}. The number of independent degrees of freedom, N depends on the time-bandwidth product (TB) and number of channels in the correlation stack, $N=2TB * N_{chan}$, where T is the length of the template window and B is the unknown bandwidth. We can get an estimate of B by measuring the variance in the correlation trace. In order to get an estimate of the noise variance we use a target window as much as 30 seconds longer than the template window in order to obtain cross-correlations of the template window with uncorrelated pre- and post-signal noise. Note that the individual channels do not necessarily provide independent measurements for the noise variance. The effective number of channels is defined as the variance reduction between the variance measured on the individual correlation traces and the one measured on the stacked correlation trace (σ^2_{eff}):

$$N_{eff} = \frac{\sum \sigma_i^2}{N \sigma_{eff}^2}$$

This allows us to determine the effective time-bandwidth (TB_{eff}) product from the expression $\sigma^2_{eff} = 1/(2TB_{eff} * N_{eff} - 3)$.

In order to be able to compare correlations measured in various effective time-bandwidth products we renormalize the Fisher transform of the maximum correlation to a value corresponding to a reference fixed time-bandwidth product. The renormalization allows us to bring all cross-correlation results into a common frame and thus set a single

significance threshold, or equivalently, define a critical value for max(z). We set the reference time-bandwidth product at 240.This time-bandwidth product is typical for regional arrays. Note that in a much narrower time-bandwidth of 15, which refers to parameters (single channel, T = 1 s, f_{high} = 15 Hz, f_{lo} = 1 Hz) typically used in local, single-channel cross-correlation analysis, the correlation at the same significance level would be 0.7. In the reference time-bandwidth product we calculate the expected maximum z from $F(\max(z))$ at the 99.5 percentile level, our choice of significance threshold, which corresponds to z_{crit} = 0.15. If the measured max(z) in the stacked correlation trace exceeds z_{crit}, we reject the null hypothesis that we are correlating noise with noise, and measure the differential time between the signals in the template and target windows.

3.2.2 Search for near-optimal time-bandwidth

The results presented in the previous section indicate that the maximum correlation depends on the actual time-bandwidth product in which it was measured. Obviously, the correlation peak is the most significant in the time-bandwidth that matches the duration and frequency content of the signal itself.

To maximize the significance, we compute cross-correlations over a suite of filter bands and durations and then estimate the effective time-bandwidth for each. From the suite of cross-correlations (with different time-bandwidth products) we select the trace with the most significant renormalized correlation to measure the differential time. Alternatively, we stack the correlation suite using inverse-variance weighting, renormalize the stacked trace, calculate the significance of the maximum renormalized correlation, and, if it is above the significance threshold, we measure the differential time on the stacked, renormalized trace. In practice we find using the "best" correlation trace provides measurements of the differential time (less cycle skipping) as reliable as using the stack.

Figure 9 shows the distribution of "best" correlations for teleseismic P and regional Pn arrivals, i.e. those filter-band and duration combinations that yielded the highest maximum renormalized correlation above the significance threshold. As expected, the peak in the P distribution is for a short window (2.5 seconds) and the 0.8-4.5Hz filter bands. However, a large proportion (> 85%) of the correlations were optimal for a wide variety of other filter band and duration combinations, indicating that there is no single optimal filter-duration combination for all teleseismic P arrivals. The lack of preferable filter band and durations is even more apparent for regional Pn phases.

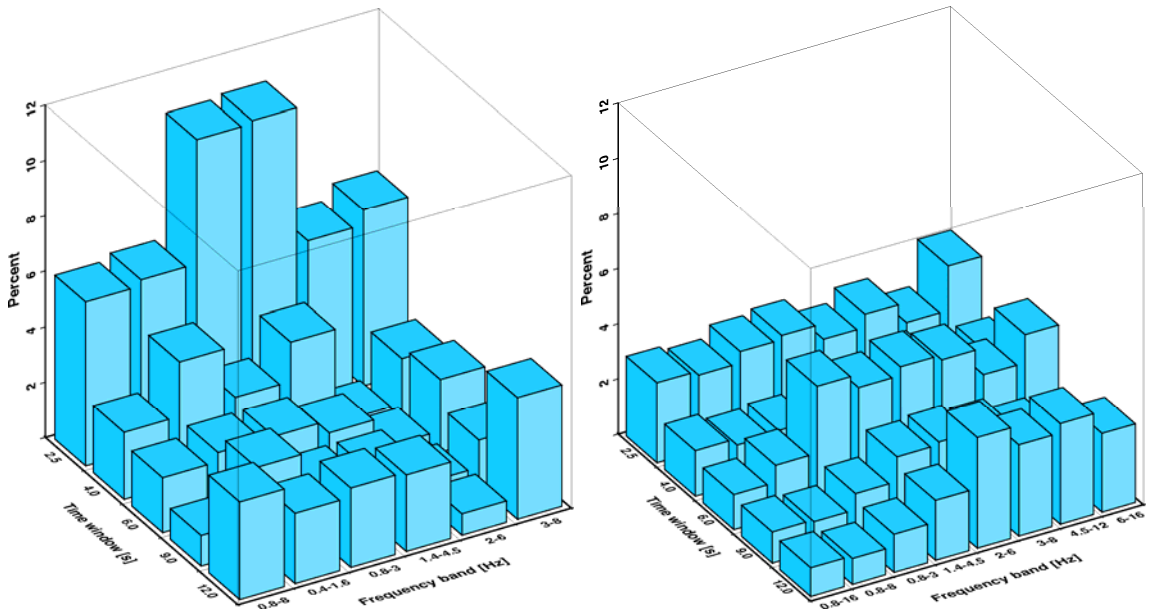

Figure 9. Histograms of best correlations in various time windows and frequency bands that yielded the highest maximum correlations above the significance threshold for a) teleseismic P, and b) regional Pn. There is no single *a priori* preferable filter and time window for either teleseismic P or regional Pn.

3.2.3 Error model for differential time uncertainties

The HDC algorithm was modified to use differential time measurements along with arrival times. Because HDC now mixes the arrival and differential times, it is important to define the proper relative weighting between the arrival and differential data. This is achieved by assigning realistic measurement uncertainties to both the absolute arrival and differential times obtained from the correlation processing. Our measurement error model for differential times was empirically derived and has a power-law dependency on the renormalized Fisher *z*-statistic.

A major challenge to quantitatively assessing a measurement error model is the lack of very accurate ground truth information, particularly for earthquake clusters, which form the bulk of the data considered in this project. To address this, we conducted a reciprocal experiment where we used clusters of seismic events (Kola Peninsula, Lop Nor and two earthquake clusters in Asia) recorded at regional and teleseismic distances at arrays. We treated each cluster of events as a pseudo-array and treated the array elements as GT0 events. Figure 10 shows the distribution of max(z) in our reference time-bandwidth product of 240 as a function of the differential time residual. The curve in red is our derived measurement error model for $z_{crit} \geq 0.15$: $\sigma_{\delta\tau} = \max\left(0.1 * 2^{-(z-0.15)/0.05}, 0.005\right)$. Note that differential time errors cannot be smaller than the sampling interval (we resample the waveforms at 200 Hz).

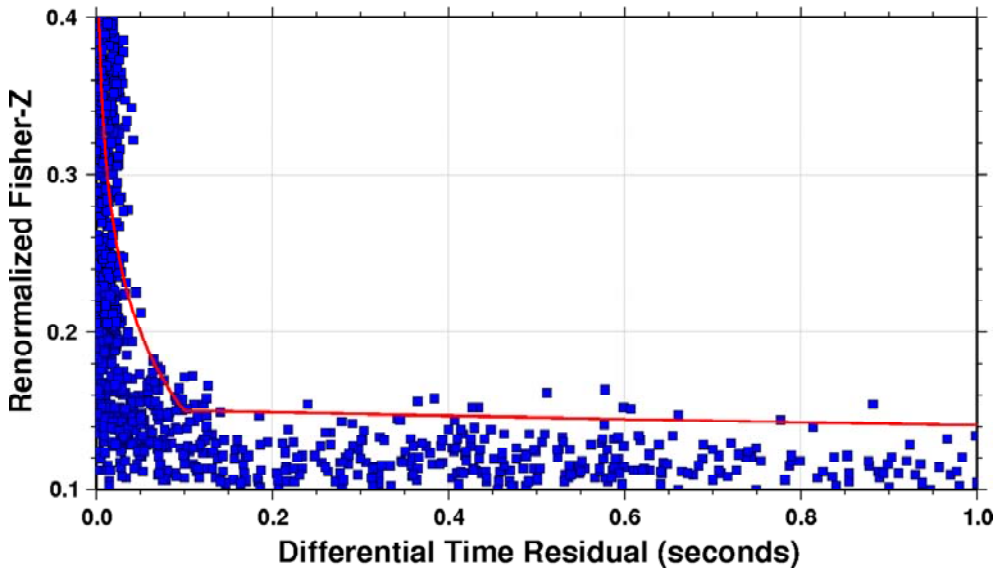

Figure 10. Differential time error model for renormalized correlations in the reference time-bandwidth product of 240. Correlations below $z_{crit} = 0.15$ are rejected.

Figure 11 demonstrates the utility of using differential times in HDC processing. The figure shows the HDC locations for the Scotty's Junction, Nevada (Ichinose et al., 2003) cluster without (Figure 11a) and with (Figure 11b) 396 differential P, Pn and Sn times. Note that the number of differential times is small compared to the 4199 bulletin picks. Even though less than 10% of the data are differential time measurements, due to their preferential weighting they yield tighter clustering of event locations and sizeable reductions in relative location uncertainties.

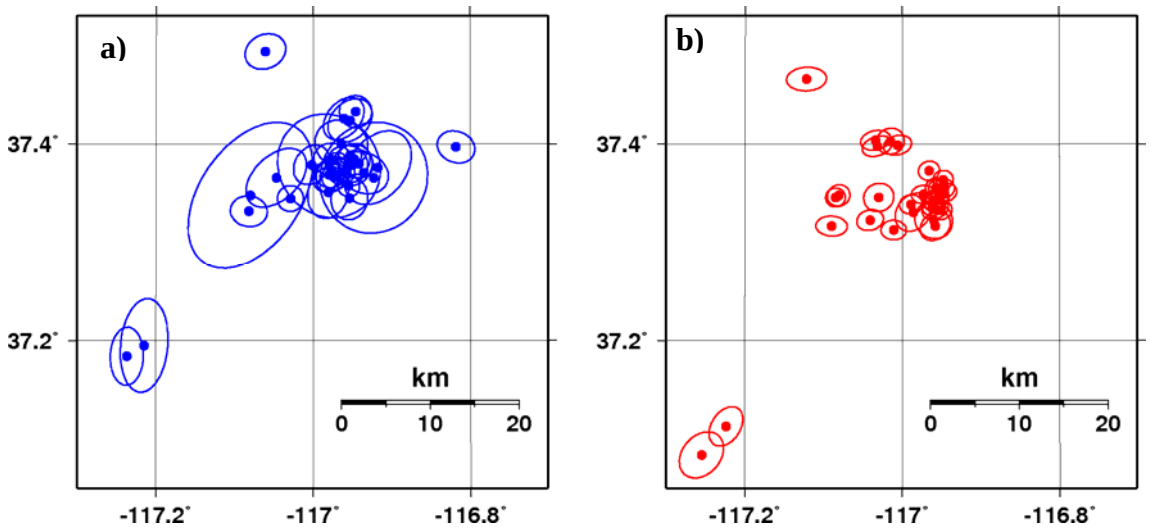

Figure 11. HDC locations for Scotty's Junction, Nevada cluster when using a) bulletin picks only and b) both bulletin data and differential times. Even a small proportion of differential times improves the event pattern and reduces relative location uncertainties.

Figure 12 shows the distribution of *a posteriori* differential time residuals for both the bulletin picks (blue) and differential times obtained from cross-correlation processing (red). When cross-correlation differential times are used in the HDC analysis (Figure 12b), HDC obtains a much tighter fit to the cross-correlation differential times, without distorting the distribution of bulletin differential residuals.

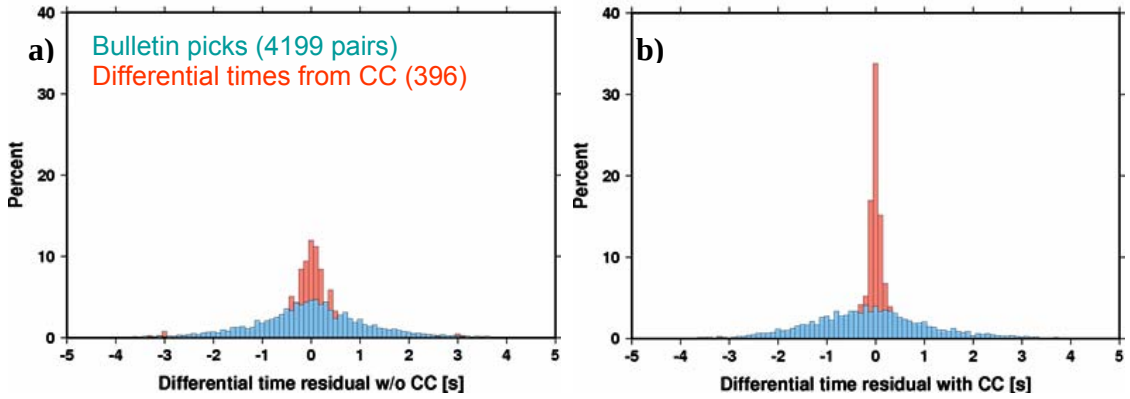

Figure 12. A posteriori distributions of differential time residuals of bulletin picks (blue) and those from waveform correlation (red) when using a) bulletin picks only and b) both bulletin data and differential times from cross-correlation analysis. The distribution of differential residuals derived from bulletin picks is nearly identical for both cases.

4. RESULTS AND DISCUSSION

During the course of the project, we have processed altogether 86 event clusters with the HDC-RCA method. Figure 13 shows the geographic distribution of the event clusters. Table 1 list the cluster names, the coordinates of the hypocentroid, the number of events in the cluster and the number of events (if any) identified as GT5. Most of the clusters were extracted from the EHB (Engdahl et al, 1998), and in a few cases we revisited clusters from past HDC analyses.

We collected waveforms from the IRIS waveform repository as well as from the IMS network to perform waveform cross-correlation and generate differential time measurements for the HDC analysis. Since the EHB spans some 40 years, many of the clusters predate the digital era of seismic data acquisition. Thus, we could produce differential time measurements for only a fraction of clusters. For clusters where we could use differential time measurements, they typically represent 10-20% of the total amount of observations (bulletin picks and differential times) used in the HDC analysis. Nevertheless, as we have shown above, only a small fraction of differential times can lead to significant improvements in the relative event locations and uncertainties.

We typically attempt to solve for all four model parameters (horizontal, vertical and origin time shift) when running RCA. However, if there are no close-in stations, we fix the event depths to those used in the HDC analysis, and solve for the lateral shift only. As we indicated in the previous chapter, even if we had no resolution on depth, we can still identify GT5 events with unknown confidence on depth.

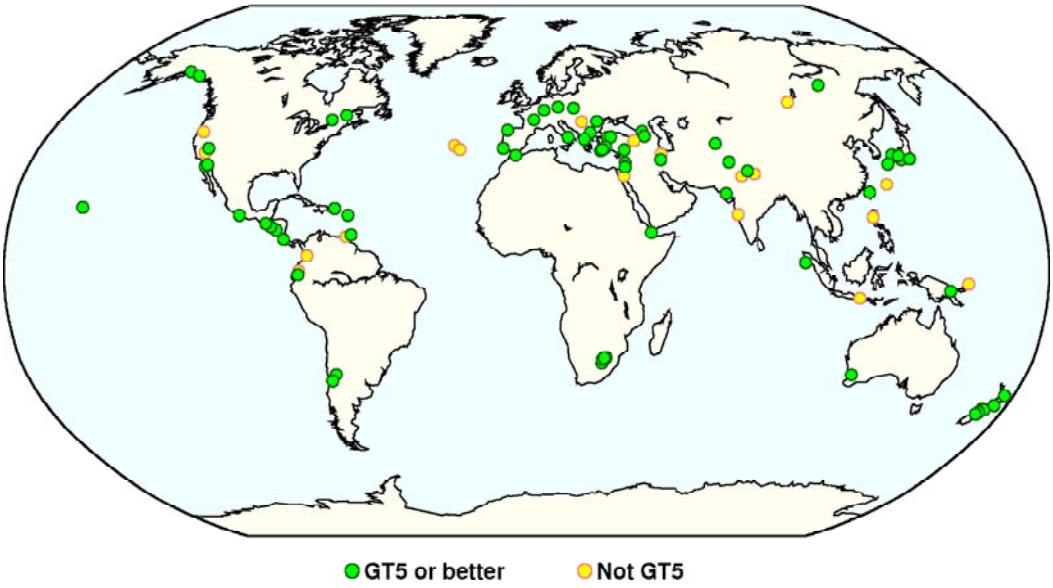

Figure 13. 86 event clusters processed during the course of the project. The 66 green dots represent clusters that produced GT5 or better event locations, yellow dots denote clusters that either failed the RCA applicability criteria or the 95% error ellipses were too large to promote any event locations to GT5.

Table 1. HDC-RCA clusters

Cid	Cluster name	Latitude	Longitude	Depth	N	NGT
5000	Scotty's Junction, Nevada	37.381	-117.106	5.0	31	31
5001	Coso, California	36.056	-117.797	3.0	53	0
10003	Gulf of Tadjoura, Djibouti	11.792	43.204	14.7	44	3
10010	Velingrad, Bulgaria	42.090	23.977	7.5	14	8
10016	Kozani-Grevena, Greece	40.099	21.624	6.4	111	111
10046	Nisyros, Greece	36.659	27.160	10.9	20	12
10047	Oren, Turkey	36.993	27.921	14.5	21	16
10049	Denizli, Turkey	37.842	29.215	7.5	17	17
10061	Vrancea, Romania	45.558	26.968	24.7	40	20
10070	Campania, Italy	40.649	15.589	5.0	178	55
10090	Timisoara, Romania	45.403	21.223	10.0	75	0
10091	Jordan River Valley, Israel	33.053	35.618	12.6	6	4
10092	Dead Sea, Israel	31.767	35.443	12.1	9	9
10093	Gulf of Aqaba, Egypt	28.871	34.773	7.4	50	0
10108	Sarria-Becerrea, Spain	42.797	-7.225	13.5	115	112
10116	Terceira, Azores Islands	38.221	-26.733	10.0	28	0
10118	Saõ Miguel, Azores Islands	37.001	-24.588	10.0	11	0
10123	Rogun, Tajikistan	38.805	69.998	12.1	24	17
10126	Alipur, Pakistan	33.217	73.369	16.7	16	6
10127	New Delhi, India	28.948	76.891	16.0	16	0
10132	Galwa, Nepal	29.564	81.588	15.0	53	0
10133	Carletonville, South Africa	-26.401	27.441	5.0	76	71
10134	Welkom, South Africa	-28.007	26.820	7.4	152	78
10137	Rabaul, New Britain, Papua New Guinea	-4.025	152.226	16.6	28	0
10140	Lae, Papua New Guinea	-6.032	146.182	19.3	67	28

10143	Mt. St. Elias, SE Alaska	60.142	-141.032	7.5	76	72
10158	Klutina Lake, S Alaska	61.509	-146.55	24.0	139	137
10206	Klamath Falls, Oregon	42.300	-122.032	8.7	36	0
10220	Luzon, Philippines	16.365	120.683	15.3	34	0
10227	Okinawa, Ryukyu, Japan	26.268	127.727	10.8	4	0
10235	Kumamoto, Kyushu	32.704	130.712	11.3	17	17
10246	Owase, W Honshu	33.967	136.207	34.4	16	14
10251	Kyoto, Honshu	35.082	135.660	2.5	19	19
10263	Miyakejima, Izu-Bonin	34.195	139.286	10.0	116	116
10279	Tottori, Honshu	35.328	133.370	7.0	13	12
10293	Bali, Indonesia	-8.192	114.979	21.1	12	0
10303	Acapulco, Guerrero, Mexico	16.966	-100.052	13.0	43	19
10309	San Vicente, El Salvador	13.617	-88.754	10.0	21	3
10310	Gulf of Fonseca, Honduras	13.115	-87.763	8.2	17	0
10313	Cerro Negro, Nicaragua	12.489	-86.713	8.1	14	11
10319	San Marcos, Costa Rica	9.696	-83.920	18.2	26	9
10324	Amatitlan, Guatemala	14.467	-90.522	10.3	11	3
10329	Quito, Ecuador	-0.113	-78.414	5.8	6	0
10330	Ambato, Ecuador	-1.094	-78.629	6.8	26	5
10342	Redonda, Leeward Islands	17.007	-62.326	15.0	15	13
10344	Tobago, Windward Islands	11.094	-60.775	5.4	25	20
10346	Gulf of Paria, Venezuela	10.540	-62.397	15.3	31	0
10361	Puente Alto, Chile	-33.530	-70.257	15.4	14	11
10362	San Juan, Argentina	-31.528	-68.579	17.0	36	3
10367	Lake Tekapo, New Zealand	-43.560	170.869	7.0	18	14
10369	Inangahua, New Zealand	-41.906	171.931	7.5	51	27
10370	Arthur's Pass, New Zealand	-43.052	171.442	11.2	55	52
10371	Lake Tennyson, New Zealand	-42.262	172.757	9.5	59	53
10378	Wellington, New Zealand	-40.979	175.309	31.4	18	17
10381	Rotorua, New Zealand	-37.993	176.664	5.5	22	19
10386	Kileaua South Flank, Hawaii	19.312	-155.267	9.5	104	56
10500	Spitak, Armenia	41.012	44.143	5.0	33	24
10501	Racha, Georgia	42.435	43.659	5.0	81	58
10502	Izmit, Turkey	40.698	30.309	13.8	107	88
10503	Duzce, Turkey	40.816	31.484	11.6	69	45
10504	Adana, Turkey	36.908	35.893	16.2	35	20
10505	Bhuj, India	23.453	70.334	21.5	32	31
10506	Koyna, India	17.234	73.743	8.1	35	0
10507	Chamoli, India	30.484	79.294	12.5	53	39
10509	Al-Hoceima, Morocco	35.211	-3.964	5.6	94	80
10510	Aldan River, Yakutsk, Russia	57.053	122.207	24.4	8	7
10511	Avaj, Iran	35.602	49.176	10.0	11	0
10512	Erzincan, Turkey	39.571	40.025	10.0	30	0
10520	Meckering, Australia	-31.617	117.053	5.0	14	9
10521	Stilfontein, South Africa	-26.891	26.799	5.7	84	71
10522	Johannesburg, South Africa	-26.222	28.202	8.6	60	48
10523	Armenia, Colombia	4.481	-75.679	17.4	9	0
10524	Dowling, Mexico	31.906	-115.935	9.3	12	12
10525	Hidalgo, Mexico	32.390	-115.249	6.1	22	20
10526	Monchique, Portugal	37.334	-8.572	11.3	6	6
10527	Cheneville, Canada	46.042	-74.939	15.8	22	21
10528	Charlevoix, Canada	47.529	-70.123	12.2	38	36
10529	Manzat, France	46.096	2.818	8.6	29	29

10530	Wadgassen, Germany	49.142	6.847	10.0	63	63
10531	Bernov, Czech Republic	50.233	12.468	7.5	75	75
10532	Cieszyn, Poland	49.855	18.499	3.5	48	48
10533	Baikal Lake, Russia	51.764	104.766	15.2	30	0
10540	Simeulue, Sumatra	2.487	95.992	19.1	33	32
10541	Puerto Rico	19.039	-67.101	24.2	31	13
10999	Dorud, Iran	33.972	48.758	8.0	65	59
30093	Chi-Chi, Taiwan	23.821	121.031	13.8	45	24

A considerable effort was devoted to collect and identify local velocity models to be used in the RCA. These are listed in Appendix A. Using local velocity models reduces the risk of introducing location biases due to unmodeled 1D local velocity structure. Since depth is as good as the velocity model, it is imperative to use local velocity models when attempting for depth inversion. We still have model errors due to 3D velocity structure unaccounted for by the local 1D velocity models used in RCA, but the local velocity model must be significantly wrong to cause appreciable distortion in the centroid location if the applicability criteria are satisfied.

4.1 Clusters with prior GT

Figure 14 shows the HDC-RCA results for the Al-Hoceima, Morocco cluster. The event cluster is constructed from the aftershock sequences of the May 26, 1994, Mw 6 and February 24, 2004, Mw 6.4 earthquakes. GT5 event locations were identified in previous HDC analyses where InSAR determinations of the main shocks were used as reference to obtain absolute locations from the HDC relative locations (Biggs et al, 2006). In this study, we use RCA to obtain absolute locations. Figure 14a shows the result of the HDC analysis. HDC (blue) improves the event pattern with respect to the EHB (green) locations. The vectors point from the EHB locations to the HDC locations. The HDC relative error ellipses are also shown around the HDC locations. The changes in the relative locations in some cases were as much as 40 km. In the RCA we used 8 stations and 66 events (Figure 14b) with a total of 368 Pg, Sg, Pn and Sn local readings. The combined secondary azimuthal gap was 89°, and we had one close-in station. We used a local velocity model reported by Stich et al. (2005) to perform RCA. Figure 14c shows that RCA shifted the entire cluster to the South by 13 km and made the hypocentroid somewhat shallower, from 7.5 km to 5.6 km. From the total number of 94 events 86 can be identified as GT5, shown as bright red in Figure 14c. Finally, as Figure 14d indicates, the RCA-determined (red) GT5 or better event locations are in good agreement with the previously identified (green) GT5 locations, as the corresponding error ellipses overlap each other.

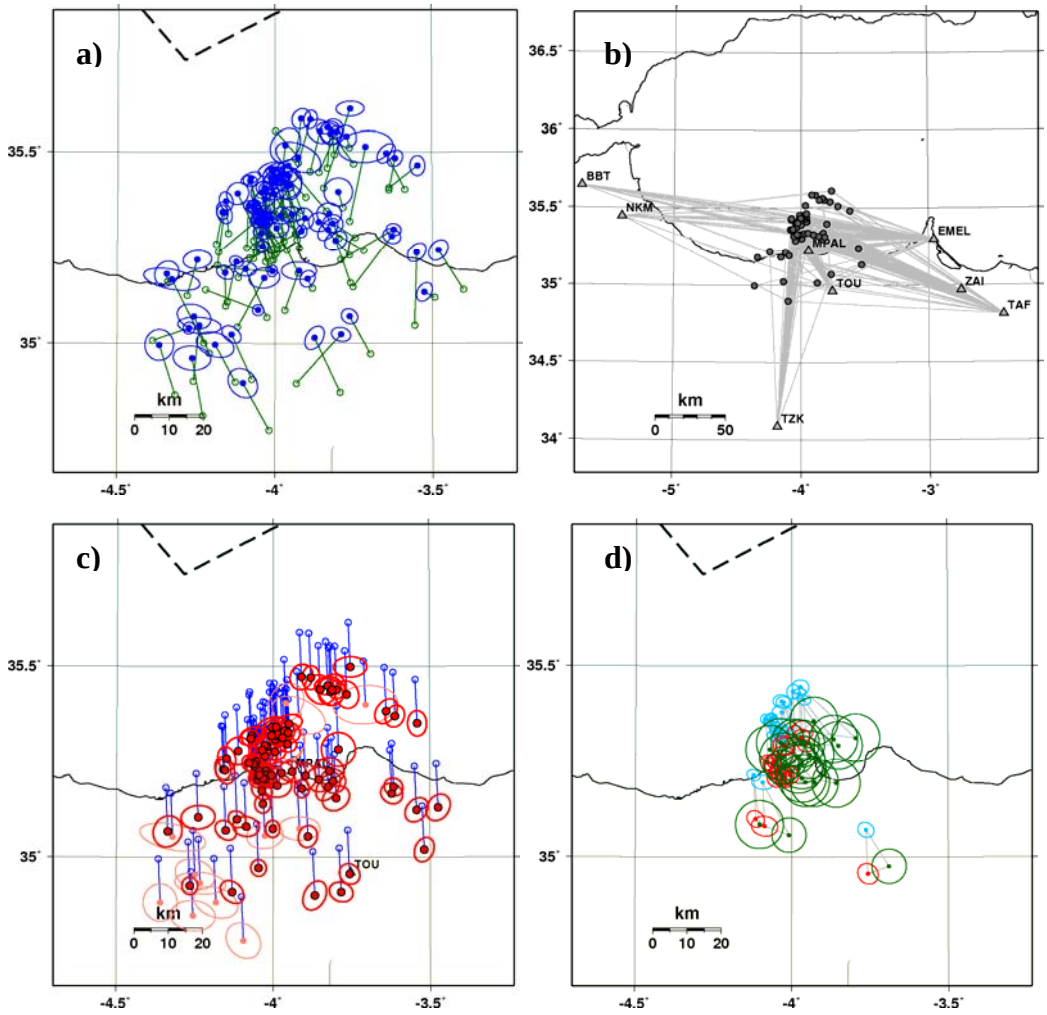

Figure 14. Al-Hoceima, Morocco cluster. a) HDC locations (blue) relative to the input EHB locations (green). b) RCA event-station geometry. c) RCA (red) shifts the HDC cluster (blue) to the south by 13 km. Events promoted to GT5 status are shown in thick red. d) The RCA locations (red) are in good agreement with prior GT (green) locations.

Figure 15 shows an event cluster built from the Chi-Chi, Taiwan aftershock sequence. Figure 15a shows the results of the HDC analysis, which used 45 events recorded by 361 regional and teleseismic stations. The dashed line represents the plate boundary between the Eurasian and Philippine Sea plates (Bird, 2003). Figure 15b shows the event-station pairs that formed the RCA cluster (11 events and 33 stations with a combined secondary azimuthal gap of 80°). RCA, using travel-time predictions from a local velocity model by Ma et al (2001), shifted the entire cluster by 18 km to the NW (Figure 15c). The hypocentroid depth remained virtually the same, as RCA shifted the cluster from 14.2 km up to 13.7 km. RCA identified 25 events as GT5. The Bondár et al (2004a) GT selection criteria identify 11 GT5 events in the EHB cluster. The comparison between the bulletin-based GT selection and the HDC-RCA GT5 events shows a good agreement as the 5 km uncertainty radii around the EHB GT5 events overlap the absolute error ellipses obtained from the HDC-RCA method (Figure 15d). Note that four of the GT5 events in the EHB bulletin were not identified as GT5 by HDC-RCA. Recall that we promote an event to

GT5 if the hypocentroid can be accepted as GT5 at the 95% confidence level, and the semi-major axis of the 95% confidence error ellipse is less than 5 km. In this case the four events were rejected because of their large error ellipses.

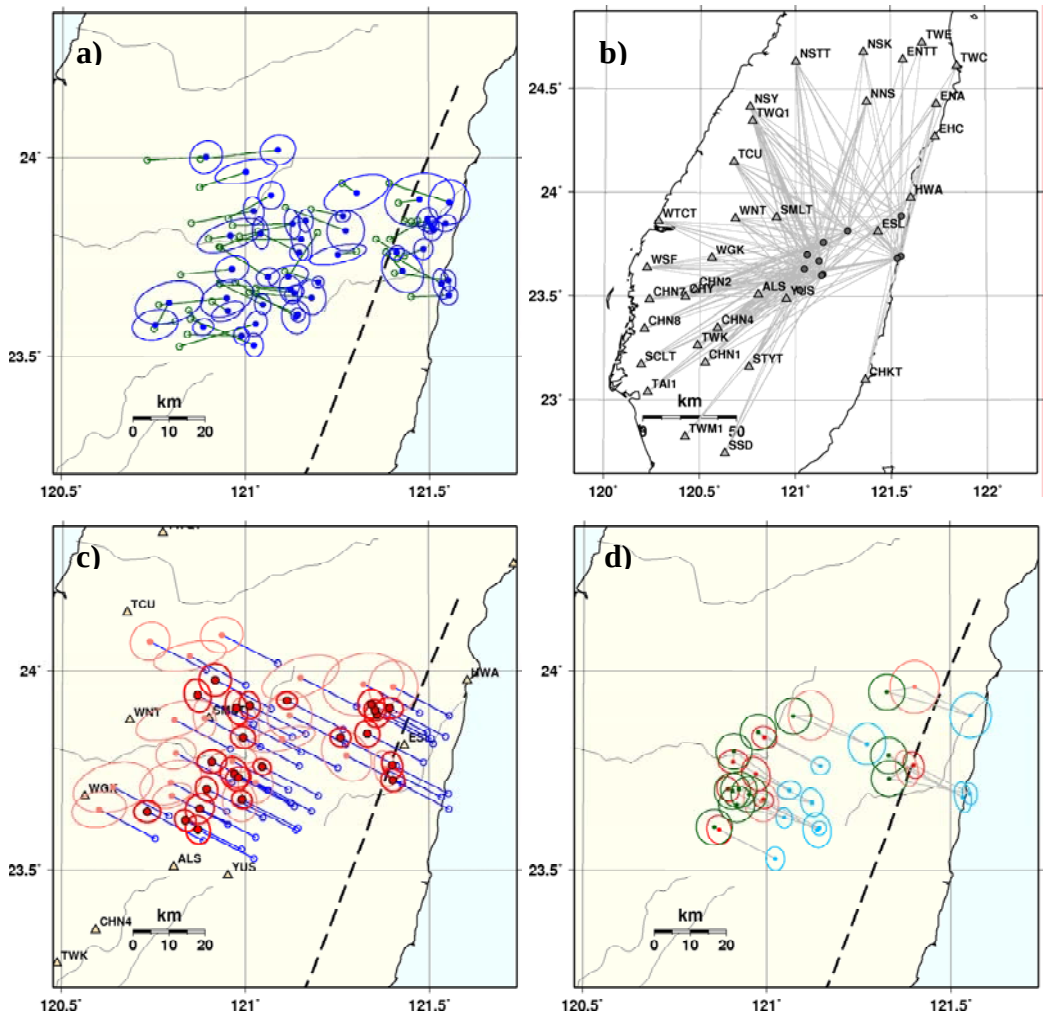

Figure 15. Chi-Chi, Taiwan cluster. a) HDC locations (blue) relative to the input EHB locations (green). b) RCA event-station geometry. c) RCA (red) shifts the HDC cluster (blue) to the NW by 18 km. Events promoted to GT5 status are shown in thick red. d) The RCA locations (red) are in good agreement with prior GT (green) locations.

Our next example is from Kumamoto, Kyushu, Japan. This event cluster is constructed from 17 events, which do not represent an aftershock sequence, but span over three decades. The Bondár et al. (2004a) GT5 selection criteria, owing to the dense local network, identify 13 of the 17 events as GT5 in the EHB bulletin. The HDC-RCA results are shown in Figure 16. In order to reduce the risk of correlated errors, we only used 9 stations from the local network (Figure 16b). RCA, using a local velocity model published by Smith et al. (2004), shifted the cluster back by 9 km to the NE and made the hypocentroid 1 km deeper (from 10 to 11 km). RCA identified all 17 events as GT5 (Figure 16c), which are excellent agreement with the previously identified GT5 (Figure

16d). It should be noted that the RCA location uncertainties scaled to the 95% level are much smaller than 5 km.

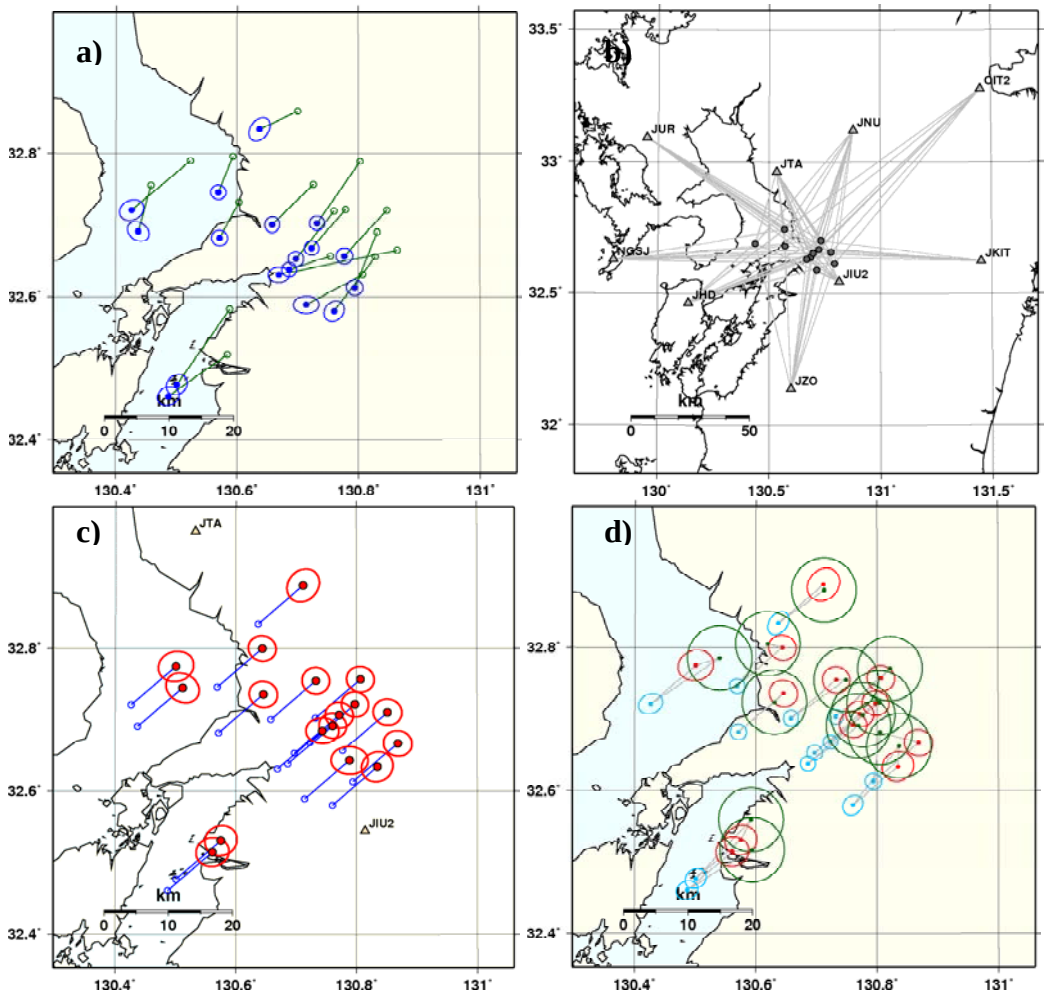

Figure 16. Kumamoto, Kyushu cluster. a) HDC locations (blue) relative to the input EHB locations (green). b) RCA event-station geometry. c) RCA (red) shifts the HDC cluster (blue) to the NE by 9 km. Events promoted to GT5 status are shown in thick red. d) The RCA locations (red) are in good agreement with prior GT (green) locations.

4.2 Clusters with no prior GT

Figure 17 shows the HDC-RCA result for the Lae, Eastern Papua New Guinea cluster. The region is an active arc-continent collision zone. The HDC cluster (Figure 17a) contained 67 events with 367 regional/teleseismic stations. RCA could use 48 events recorded by 5 stations (Figure 17b) with a combined secondary gap of 132°. We used a local velocity model by Abers and Roecker (1991) to predict travel-times for the local phases. Since there were no close-in stations from the centroid, we fixed the depths of the events to those used in the HDC analysis, thus leaving the hypocentroid depth at 19 km. RCA shifted the cluster by 10 km towards the Ramu Markham fault shown as the dashed line in Figure 17c. Finally, we could identify 28 events as GT5.

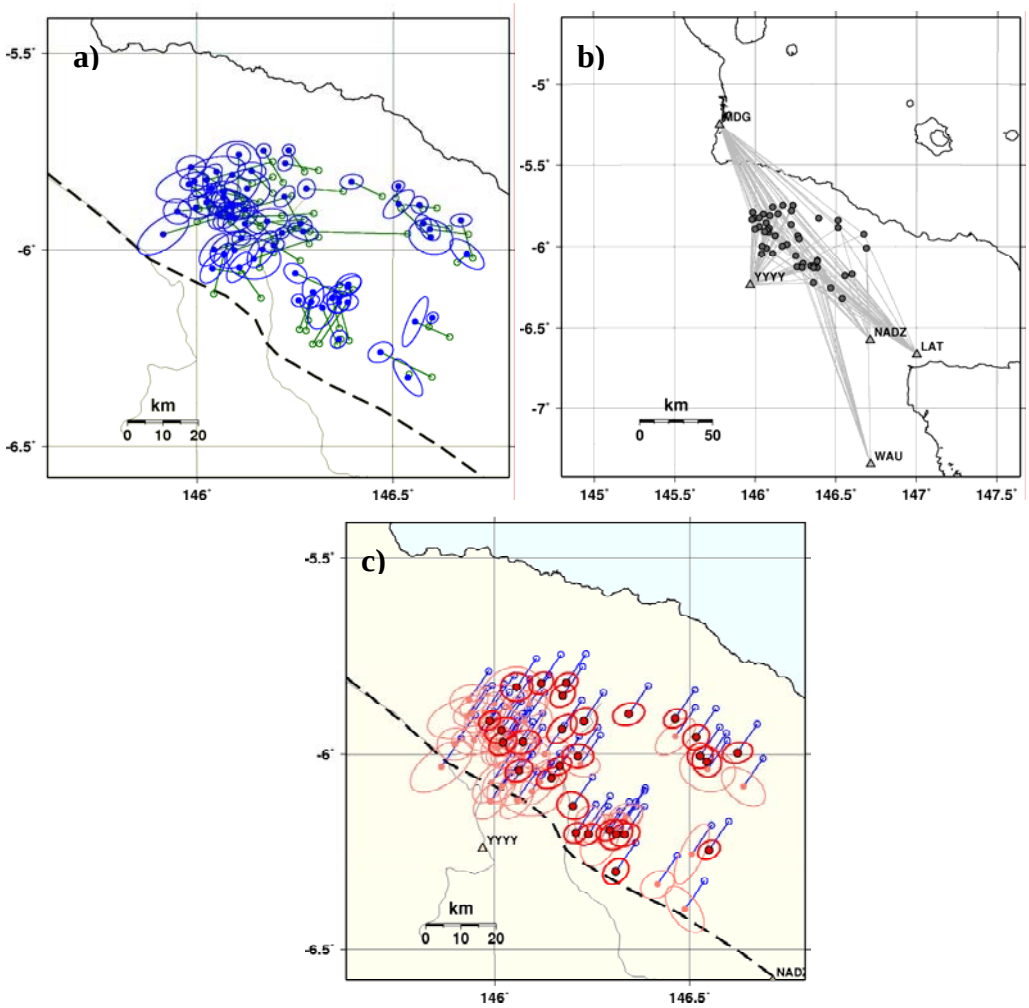

Figure 17. Lae, Papua New Guinea cluster. a) HDC locations (blue) relative to the input EHB locations (green). b) RCA event-station geometry. c) RCA (red) shifts the HDC cluster (blue) to the SE by 10 km toward the Markham fault (dashed line) Events promoted to GT5 status are shown in bright red.

The Rogun, Tajikistan cluster is located between the South Tien Shan and the Northern Pamir mountains. This region is characterized by the shallow seismicity along the Vaksh and Darvaz faults (Pegler and Das, 1998). The HDC cluster (Figure 18a) consisted of 24 events with 376 regional/teleseismic stations. Altogether 13 events recorded by only 3 stations passed the RCA connectivity tests (Figure 18b). Even though we had only 3 stations, the RCA geometry is so favorable that the combined secondary azimuthal gap was only 110°. We used a local velocity model by Hamburger et al (1993) to predict travel-times for the 44 Pg and Sg readings. Again, we had no close-in stations, so we ran RCA with a fixed depth solution (hypocentroid depth at 12 km). RCA shifted the entire cluster to the Vaksh river valley (Figure 18c) which is the surface expression of the Vaksh fault. The HDC-RCA analysis resulted in 17 GT5 events.

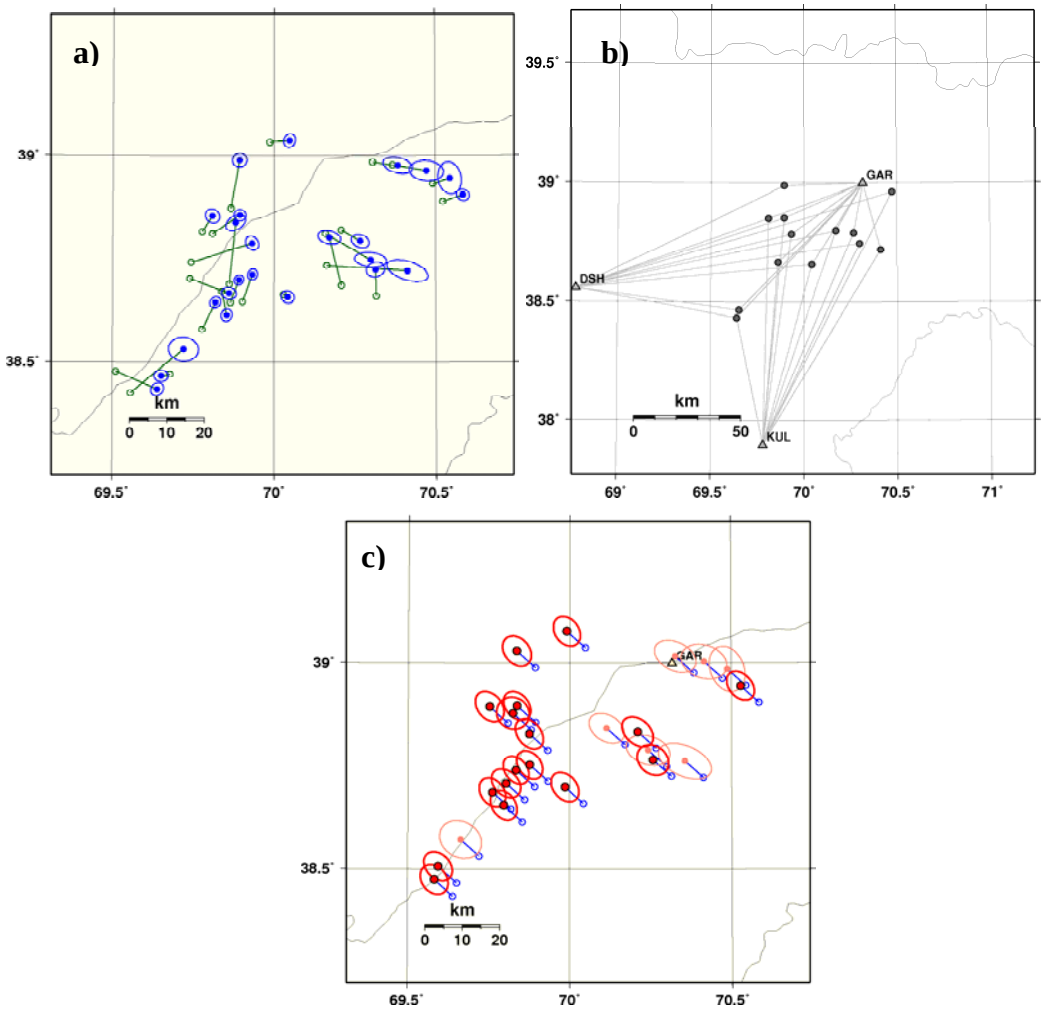

Figure 18. Rogun, Tajikistan cluster. a) HDC locations (blue) relative to the input EHB locations (green). b) RCA event-station geometry. c) RCA (red) shifts the HDC cluster (blue) to the NW by 7 km aligning with the Vaksh fault. Events identified as GT5 are shown in bright red.

4.3 Clusters where RCA fails to produce GT

The Erzincan, Turkey cluster is located on the North Anatolian fault. Figure 19a shows the HDC cluster which consists of 36 events, recorded by 666 regional and teleseismic stations. GT5 event locations were identified by a previous HDC analysis (Engdahl and Bergman, 2001). RCA could use 6 events and 5 stations, representing 17 Pg and Pn readings (Figure 19b) with a combined secondary azimuthal gap of 173°. We used a local velocity model reported by Kaypak and Eyidogan (2005) to perform the RCA. RCA shifted the cluster by 10 km to the NE (Figure 19c). In spite of the excellent agreement between the previously determined GT5 and RCA locations (Figure 19d) we cannot promote any of the RCA locations to GT5 level with high confidence because the cluster does not satisfy our applicability criteria, violating both requirements (the combined secondary azimuthal gap is larger than 140°, and there are less than 25

observations). Furthermore, the absolute location uncertainties are too large (all the semi-major axes of the error ellipses exceed 5 km) to accept any events as GT5.

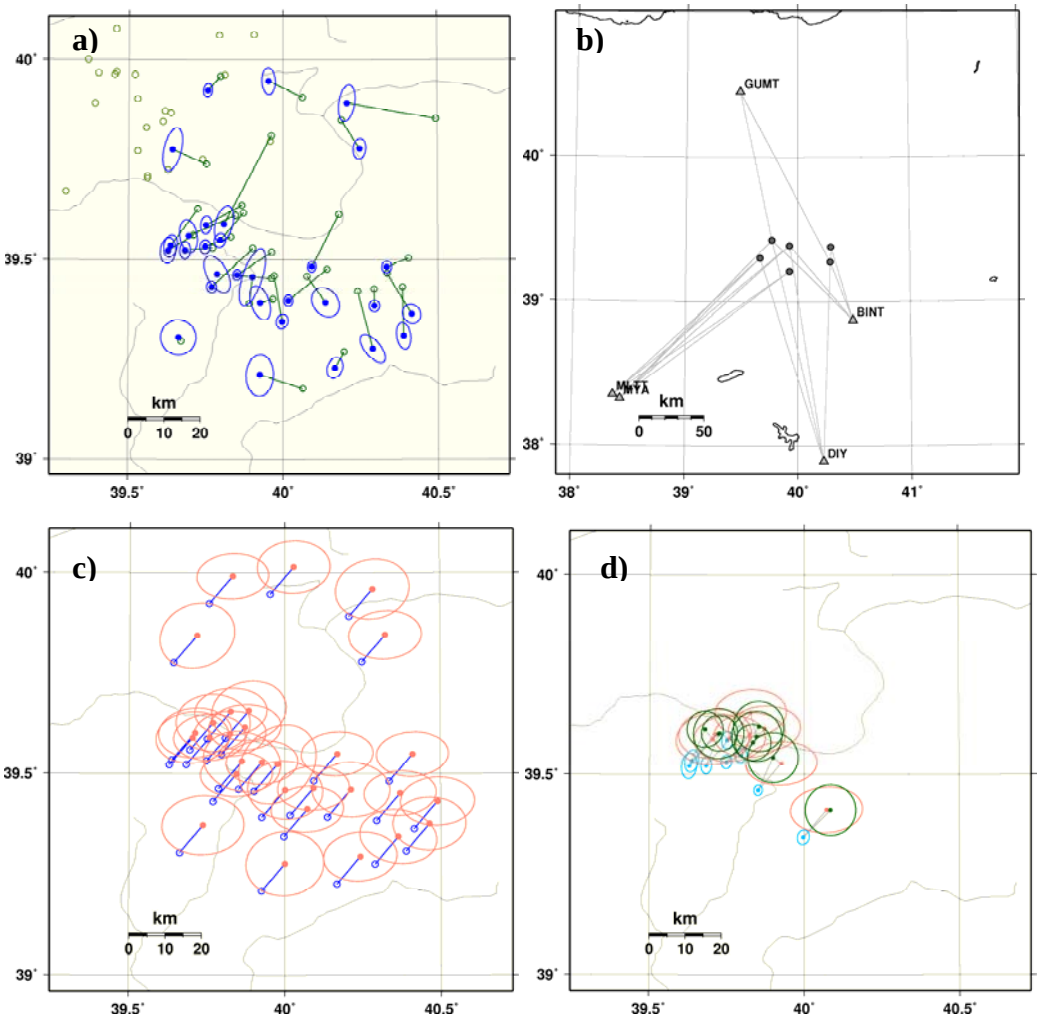

Figure 19. Erzincan, Turkey cluster. a) HDC locations (blue) relative to the input EHB locations (green). b) RCA event-station geometry. c) RCA (red) shifts the HDC cluster (blue) to the NE by 10 km. No events are promoted to GT5 status because RCA fails the applicability criteria. d) The RCA locations (red) are in good agreement with prior GT (green) locations.

Finally we show an example from the triple junction of African, European and Atlantic plates. Figure 20a shows the HDC results for a cluster near Terceira Island in the Azores. We used the ak135 oceanic velocity model (Kennett et al., 1995) to predict travel-times to the local stations used in the RCA. Note that the combined secondary azimuthal gap is 148°, which prevents us from identifying any GT5 events at a high confidence level. Nevertheless, as Figure 20c illustrates, RCA moves the cluster toward the plate boundary between Africa and Europe. Thus, even if we could not identify GT events at a high confidence level, due to the improved relative locations and reduced bias,

the evidence suggests that HDC-RCA locations are still better than single event locations published in bulletins.

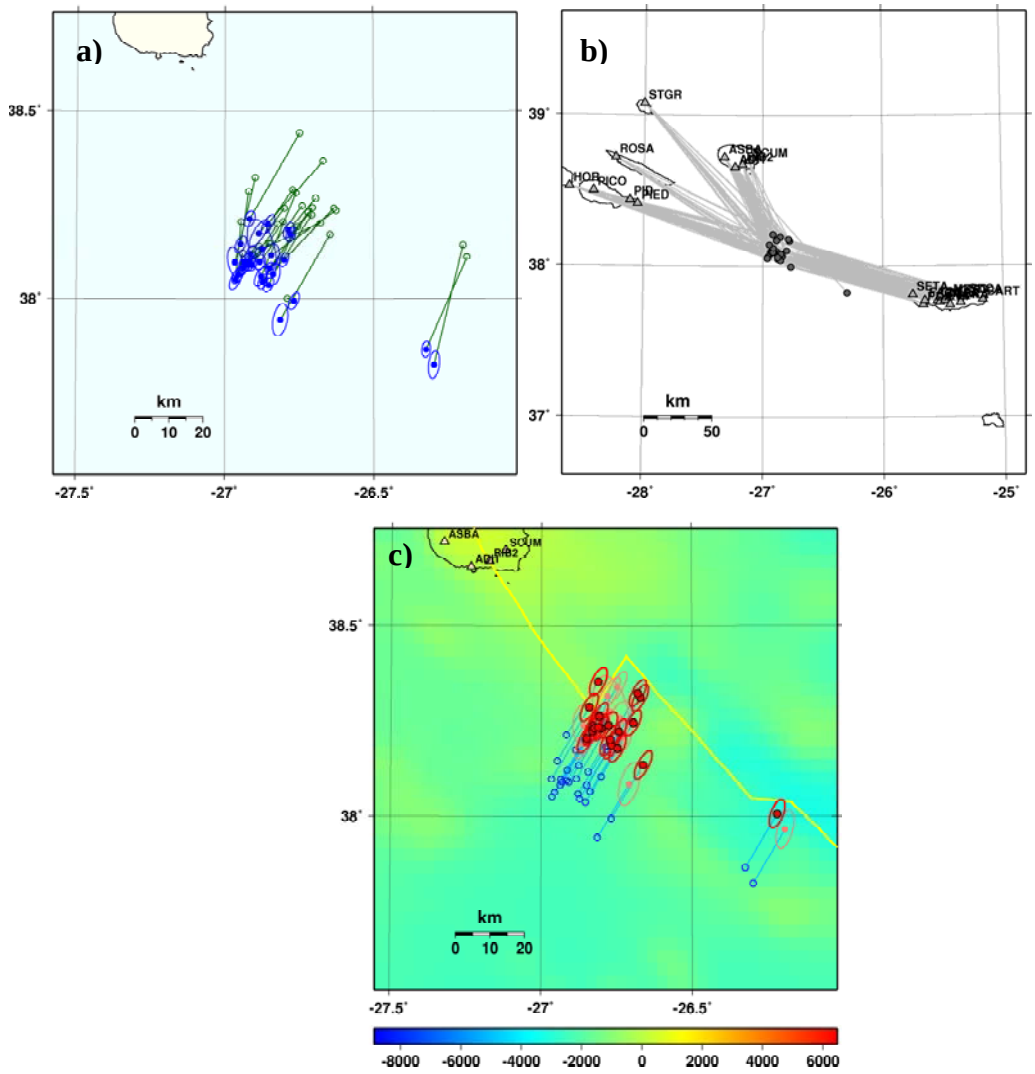

Figure 20. Terceira Island, Azores cluster. a) HDC locations (blue) relative to the input EHB locations (green). b) RCA event-station geometry. c) RCA (red) shifts the HDC cluster (blue) to the NW by 18 km toward the African-European plate boundary. Even though the error ellipses are small, no events are promoted to GT5 status because the cluster fails the RCA applicability criteria.

4.4 Discussion

We have shown that GT5 events identified by the HDC-RCA are consistent with previously determined GT information. The distribution of distances between GT5 events identified by RCA and 430 prior GT0-10 events is shown in Figure 21a. Figure 21b shows the distribution of the semi-major axis of the 95% error ellipses for all events in the HDC-RCA clusters. Note that the semi-major axis is smaller than 5 km for 75% of the events and smaller than 10 km for 95% of the events. Thus, based on the location

uncertainties, almost all events would qualify for GT10, and we could have promoted many more events to GT5 than we actually did. However, we opted for a rather conservative approach to minimize false alarms, as we would rather miss GT5 events than contaminate the reference event set with events that should not qualify for GT5.

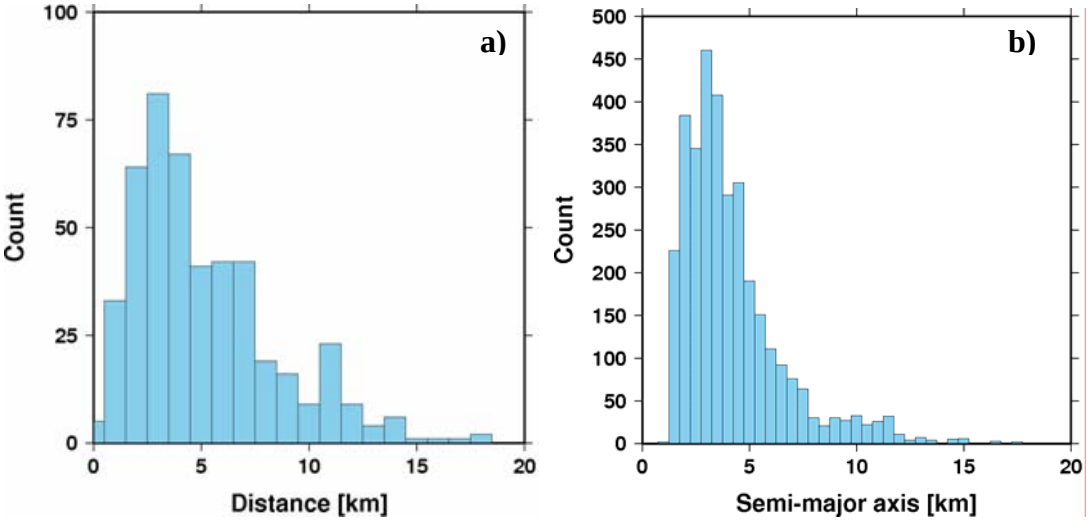

Figure 21. a) Distance distribution between RCA GT5 and prior 430 GT0-10 events. b) Histogram of the semi-major axis of the 95% error ellipse for all events in the RCA clusters.

When designing the Monte Carlo experiments to determine applicability criteria for the RCA we aimed for the worst case scenario, when even a perfectly balanced network would introduce location bias. A real-world example for such a scenario is the San Andreas fault. Because the travel-time biases in the Monte Carlo experiment represented approximately ±5% velocity variations for local phases, they consider them as reasonable upper bounds for local velocity anomalies. Hence, the resulting applicability criteria bound the local biases by imposing geometrical constraints on the local network.

The strength of the HDC-RCA methodology is manifested when only a few local favorably located stations are available. Richards et al (2006) point out that in order to achieve improved locations for more than 25% of the events in a cluster using the double-difference algorithm with differential times from waveform cross-correlation, a high local station density (one station per 100 km^2 and about 12 km distance between stations) is required. Owing to the natural separation of tasks in the HDC-RCA methodology (HDC resolves the event pattern using regional and teleseismic stations, RCA reduces the bias in the hypocentroid using local data), the applicability of RCA is not restricted by such strong conditions on station density. As long as the RCA geometry is favorable, HDC-RCA is capable of producing GT events even with very sparse local station coverage.

Recall that RCA treats the HDC event cluster as if it were a rigid pattern and shifts the cluster without changing the event pattern. Since regional and teleseismic first arriving P phases lack the resolution to resolve the full depth pattern in a cluster, in the HDC analysis event depths are typically fixed to educated guesses, based on a

preliminary analysis of individual events with reported depth phases and local P and S phases, as well as waveform analyses. Therefore RCA may improve the hypocentroid (average) depth, but not the depth pattern. However, the local data may have enough resolution to resolve the depth, at least for a subset of events. In general, local data can resolve the depth if there are stations covering the distance range where the vertical partial derivative of the travel-time of the first arriving phase changes sign, or, in other words, if we have a mixture of downgoing and upgoing waves. This is expressed in the HDC-RCA applicability criteria by the somewhat rudimentary criterion that requires at least one close-in station in order to be able to resolve the hypocentroid depth at a high confidence level. One possible way to improve the depth pattern in the cluster is to identify those events for which the local stations provide depth resolution and for these events perform a grid search in depth and origin time by keeping the epicenter fixed. The depth of the rest of the events would be adjusted so that the hypocentroid depth, resolved by the HDC-RCA, remains the same.

5. CONCLUSIONS

During the course of the project, we have developed a novel multiple event location method, the hybrid HDC-RCA algorithm. We have shown that HDC-RCA neither relies upon the existence of dense local networks, nor upon the existence of prior GT information. GT5 events identified by HDC-RCA are consistent with previously determined GT information. The methodology is capable of producing GT5 or better events from event clusters where other methods would not.

We applied our cross-correlation methodology to all clusters for which waveform data could be obtained at regional and teleseismic distances. We collected waveforms from both IMS network stations and from the IRIS waveform repository for as many event-station pairs as possible. We processed about 870,000 pairs of arrivals from 47 clusters yielding about 9,200 significant correlations. We used the differential time measurements in HDC analysis for 15 clusters. For these 15 clusters, the large scale correlation processing produced 4,709 significant correlations, and thus accurate differential time measurements, of which 3,624 were used in the HDC analysis after outlier rejection.

We processed 86 clusters with the hybrid HDC-RCA analysis. Most of the clusters were extracted from an updated EHB (Engdahl et al., 1998) bulletin while in a few cases we added local data (e.g. aftershock deployments) not reported to the ISC. We primarily focused on areas with sparse local networks. These are regions where the HDC-RCA methodology shows its real strength compared to other multiple event location methods. Our objective was to achieve a balanced global coverage of GT5 events. We also re-analyzed several classic clusters for additional cross-validation with past work (e.g. Al-Hoceima, Racha, etc). From the 86 event clusters, 66 clusters produced altogether 2,279 GT5 or better events listed in Appendix B.

Our data delivery include the complete catalog (CSS tables) of over 3,000 event HDC and RCA locations, phase arrivals, waveforms and selected path corrections as well as

the documentation of the database schema. We also deliver a presentation of the event clusters (EHB, HDC and RCA locations) in Google Earth format.

REFERENCES

Abers, G.A. and S.W. Roecker (1991). Deep structure of an arc-continent collision: Earthquake relocation and inversion for upper mantle P and S wave velocities beneath Papua New Guinea, *J. Geophys. Res*., **96**, 6379-6401.

Bergman, E.A. and E.R. Engdahl (2007). Multiple event relocation for reference seismic events, *in preparation*.

Biggs, J., E. Bergman, B. Emmerson, G.J. Funning, J. Jackson, B. Parsons and T.J. Wright (2006). Fault identification for buried strike-slip earthquakes using InSAR: The 1994 and 2004 Al Hoceima, Morocco earthquakes *Geophys. J. Int.,* **166**, 1347-1362, doi: 10.1111/j.1365-246X.2006.03071.x.

Bird, P. (2003). An updated digital model of plate boundaries, *Geochemistry Geophysics Geosystems*, **4**, 3, doi: 10.1029/2001GC000252.

Bondár, I., S.C. Myers, E.R. Engdahl, and E.A. Bergman (2004a). Epicentre accuracy based on seismic network criteria, *Geophys. J. Int.,* **156**, 1-14, doi: 10.1046/j.1365-246X.2004.02070.x.

Bondár, I., E.R. Engdahl, X. Yang, H.A.A. Ghalib, A. Hofstetter, V. Kirichenko, R. Wagner, I. Gupta, G. Ekström, E. Bergman, H. Israelsson and K. McLaughlin (2004b). Collection of a reference event set for regional and teleseismic location calibration, *Bull. Seism. Soc. Am.,* **94**, 1528-1545.

Bondár, I., B. Kohl, E. Bergman, K. McLaughlin, H. Israelsson, Y-L. Kung, P. Piraino and E.R. Engdahl (2005). Global ground truth data set with waveform and improved arrival data, *27th Seismic Research Review*, Palm Springs, CA Sept. 20-22, 2005.

Bondár, I., B. Kohl, E. Bergman, K. McLaughlin, H. Israelsson, Y-L. Kung, J. Given and E.R. Engdahl (2006). Global ground truth data set with waveform and improved arrival data, *28th Seismic Research Review*, Orlando, FL, September 19-21, 2006.

Bondár, I., B. Kohl, E. Bergman, K. McLaughlin, Y-L. Kung and E.R. Engdahl (2007a). Global ground truth data set with waveform and improved arrival data, *29th Monitoring Research Review*, Denver, CO, September 19-21, 2007.

Bondár, I., E. Bergman, E.R. Engdahl, B. Kohl, Y-L. Kung and K. McLaughlin (2007b). A hybrid multiple event location technique to obtain ground truth event locations, submitted to *Geophys. J. Int*.

Engdahl, E.R. and E.A. Bergman (2001). Validation and generation of reference events by cluster analysis, *23rd Seismic Research Review*, Jackson Hole, WY, October 2-5, 2001.

Engdahl, E.R., R.D. van der Hilst, and R.P. Buland (1998). Global teleseismic earthquake relocation with improved travel times and procedures for depth determination, *Bull. Seism. Soc. Am.*, **88**, 722-743.

Fisk, M. (2002). Accurate locations of nuclear explosions at the Lop Nor Test Site using alignment of seismograms and IKONOS satellite imagery, *Bull. Seism. Soc. Am.,* **92**, 2911-2925.

Gibbons, S.J. and F. Ringdal (2006). The detection of low magnitude seismic events using array-based waveform correlation, *Geophys. J. Int*., **165**, 149-166.

Gibbons, S.J., M.B. Sorensen, D.B. Harris and F. Ringdal (2007). The detection and location of low magnitude earthquakes in northern Norway using multi-channel waveform correlation at regional distances, *Phys. Earth Planet. Int*., **160**, 285-309.

Got, J-L. J. Fréchet and F.W. Klein (1994). Deep fault plane geometry inferred from multiple relative relocation beneath the south flank of Kileaua, *J. Geophys. Res.,* **99**, 15375-15,386.

Hamburger, M.W., W.A. Swanson II and G.A. Popandopulo (1993). Velocity structure and seismicity of the Garm region, Central Asia, *Geophys. J. Int.,* **115**, 497-511.

Harris, D.B. (1991). A waveform correlation method for identifying quarry explosions, *Bull. Seism. Soc. Am.,* **81**, 2395-2418.

International Seismological Centre, On-line Bulletin, http://www.isc.ac.uk/Bull, Internatl. Seism. Cent., Thatcham, United Kingdom, 2001.

Israelsson, H. (1990). Correlation of waveforms from closely spaced regional events, *Bull. Seism. Soc. Am.,* **80**, 2177-2193.

Jordan, T.H. and K.A. Sverdrup (1981). Teleseismic location techniques and their application to earthquake clusters in the south-central Pacific, *Bull. Seism. Soc. Am.*, **71**, 1105-1130.

Kaypak, B., and H. Eyidogan (2005). One-dimensional crustal structure of the Erzincan basin, Eastern Turkey and relocations of the 1992 Erzincan earthquake (Ms-6.8) aftershock sequence, *Phys. Earth Planet. Int.*, **151**, 1-20.

Kennett, B.L.N. and E.R. Engdahl (1991). Travel times for global earthquake location and phase identification, *Geophys. J. Int*., **105**, 429-465.

Kennett, B.L.N., E.R. Engdahl and R.P. Buland (1995). Constraints on seismic velocities in the Earth from travel times, *Geophys. J. Int*., **122**, 108-124.

Ma, K-F., J. Mori, S-J. Lee and S.B. Yu (2001). Spatial and temporal distribution of slip for the 1999 Chi-Chi, Taiwan, earthquake, *Bull. Seism. Soc. Am.*, **91**, 1069-1087.

Massa, M., G. Ferretti, D. Spallarosa and C. Eva (2006). Improving automatic location procedure by waveform similarity analysis: an application in the South Western Alps (Italy), *Phys. Earth Planet. Int.*, **154**, 18-29.

Orwant, J., J. Hietaniemi and J. Macdonald (1999). *Mastering Algorithms with Perl*, O'Reilly & Associates, Inc., Sebastopol.

Pan, J., M. Antolik, and A.M. Dziewonski (2002). Locations of mid-oceanic earthquakes constrained by seafloor bathymetry, *J. Geophys. Res*. **107**, B11, 2310, EPM 8 1-13, doi: 10.1029/2001JB001588.

Parsons, B., T. Wright, P. Rowe, J. Andrews, J. Jackson, R. Walker, M. Khatib, M. Talebian, E. Bergman and E.R. Engdahl (2006). The 1994 Sefidabeh (eastern Iran) earthquakes revisited: new evidence from satellite radar interferometry and carbonate

dating about the growth of an active fold above a blind thrust fault, *Geophys. J. Int.,* **164**, 202-217, doi: 10.1111/j.1365-246X.2005.02655.x.

Poupinet, G., W.L. Ellsworth and J. Fréchet (1984). Monitoring velocity variations in the crust using earthquake doublets: an application to the Calaveras fault, California, *J. Geophys. Res.,* **89**, 5719-5731.

Richards, P.G., F. Waldhauser, D. Schaff and W-Y Kim (2006). The applicability of modern methods of earthquake location, *Pure appl. geophys*., **163**, 2-3, 351-372, doi: 10.1007/s00024-005-0019-5.

Ritsema, J. and T. Lay (1995). Long-period regional wave moment tensor inversion for earthquakes in the western United States, *J. Geophys. Res.*, **100**, 9853-9864.

Ritzwoller, M.H., N.M. Shapiro, E.A. Levshin, E.A. Bergman and E.R. Engdahl (2003). Ability of a global three-dimensional model to locate regional events, *J. Geophys. Res.,* **108**, B7, 2353, doi: 10.1029/2002JB002167.

Rowe, C.A., R.C. Aster, B. Borchers and C.J. Young (2003). An automatic adaptive algorithm for refining phase picks in large seismic data sets, *Bull. Seism. Soc. Am.,* **92**, 1660-1674.

Schaff, D. and P.G. Richards (2004). Lg-wave cross-correlation and double-difference location: application to the Xiuyan, China Seq., *Bull. Seism. Soc. Am.*, **94**, 867-879.

Schaff, D., G. H. R. Bokelmann, W. L. Ellsworth, E. Zanzerkia, F. Waldhauser and G. C. Beroza (2004). Optimizing correlation techniques for improved earthquake location, *Bull. Seism. Soc. Am.*, **94**, 705-721.

Shearer, P. (1997). Improving local earthquake locations using the L1 norm and waveform cross correlation: Application to the Whittier Narrows, California, aftershock sequence, *J. Geophys. Res.*, **102**, 8269-8283.

Smith, A.J., P.R. Cummins, T. Baba, S. Kodaira, Y. Kaneda and H. Yamaguchi (2004). Intra-plate seismicity in the subducting Philippine Sea Plate, southwest Japan: magnitude-depth correlations, *Phys. Earth Planet. Int.*, **145**, 179-202.

Stich, D., F. Mancilla, D. Baumnot and J. Morales (2005). Source analysis of the Mw 6.3 2004 Al Hoceima earthquake using regional apparent source time functions, *J. Geophys. Res*., **110**, B06306, doi:10.1029/2004JB003366.

Thurber, C. H., W-X Du, H. Zhang and W.J. Lutter (2003). Methods for improving seismic event location processing, *25th Seismic Research Review Review,* LA-UR-03-6029, **3**, 342-351.

VanDecar, J.C. and R.S. Crosson (1990). Determination of teleseismic relative phase arrival times using multi-channel cross-correlation and least squares, *Bull. Seism. Soc. Am.,* **80**, 150-169.

Waldhauser, F. and W.L. Ellsworth (2000). A double-difference earthquake location algorithm: Method and application to the Northern Hayward fault, California, *Bull. Seism. Soc. Am.,* **90**, 1353-1368.

Waldhauser, F. and P.G. Richards (2004). Reference events for regional seismic phases at IMS stations in China, *Bull. Seism. Soc. Am.*, **94**, 2265-2279.

Walker, R.T., E. Bergman, J.Jackson, M. Ghorashi and M. Talebian (2005). The 2002 June 22 Changureh (Avaj) earthquake in Qazvin province, northwest Iran: epicentral relocation, source parameters, surface deformation and geomorphology, *Geophys. J. Int.,* **160**, 707-720, doi: 10.1111/j.1365-246X.2005.02516.x.

Wolfe, C.J. (2002). On the mathematics of using difference operators to relocate earthquakes, *Bull. Seism. Soc. Am.,* **92**, 2879-2892.

Zhang, H. and C.H. Thurber (2003). Double-difference tomography: The method and its application to the Hayward fault, California, *Bull. Seism. Soc. Am.,* **93**, 1875-1889.

APPENDIX A

Table 2 lists the total number of events, the number of events promoted to GT5 and the reference to the local velocity model used in the RCA for each cluster.

Table 2. Local velocity models used in RCA

Cid	Cluster name	N/NGT	Reference
5000	Scotty's Junction, Nevada	31/31	Ritsema, J. and T. Lay, Long-period regional wave moment tensor inversion for earthquakes in the western United States, *J. Geophys. Res.*, **100**, 9853-9864, 1995.
5001	Coso, California	53/0	Ritsema, J. and T. Lay, Long-period regional wave moment tensor inversion for earthquakes in the western United States, *J. Geophys. Res.*, **100**, 9853-9864, 1995.
30093	Chi-Chi, Taiwan	45/24	Ma, K-F., J. Mori, S-J. Lee and S.B. Yu, Spatial and temporal distribution of slip for the 1999 Chi-Chi, Taiwan, earthquake, *Bull. Seism. Soc. Am.*, **91**, 1069-1087, 2001.
10003	Gulf of Tadjoura, Djibouti	44/3	Dugda, M.T. and A.A. Nyblade, New constraints on crustal structure in eastern Afar from the analysis of receiver functions and surface wave dispersion in Djibouti, in: Yirgu, G., C.J. Ebinger and P.K.H. Maguire (eds), *The Afar Volcanic Province within the East African Rift System*, Geological Society, London, Special Publications, **259**, 239-251, 2006.
10010	Velingrad, Bulgaria	14/8	Botev, E. and T. Toteva, Preliminary results of 3-D modeling of the earth crust in SW Bulgaria and some adjacent regions, *Bulg. Geophys. J.*, **26**, 1-4, 2000.
10016	Kozani-Grevena, Greece	111/111	Resor, P.G., D.D. Pollard and G.C. Beroza, Integrating high-precision aftershock locations and geodetic observations to model coseismic deformation associated with the 1995 Kozani-Grevena earthquake, Greece*, J. Geophys. Res.,* **110**, B09402, doi: 10.1029/2004JB003263, 2005.
10046	Nisyros, Greece	20/12	Horasan, G., L. Gülen, A. Pinar, D. Kalafat, N. Özel, H.S. Kuleli and A.M. Işikara, Lithospheric structure of the Marmara and Aegean regions, Western Turkey, *Bull. Seism. Soc. Am.*, **92**, 322-329, 2002.
10047	Oren, Turkey	21/16	Horasan, G., L. Gülen, A. Pinar, D. Kalafat, N. Özel, H.S. Kuleli and A.M. Işikara, Lithospheric structure of the Marmara and Aegean regions, Western Turkey, *Bull. Seism. Soc. Am.*, **92**, 322-329, 2002.
10049	Denizli, Turkey	17/17	Horasan, G., L. Gülen, A. Pinar, D. Kalafat, N. Özel, H.S. Kuleli and A.M. Işikara, Lithospheric structure of the Marmara and Aegean regions, Western Turkey, *Bull. Seism. Soc. Am.*, **92**, 322-329, 2002.
10061	Vrancea, Romania	40/20	Landes, M., W. Fielitz, F. Hauser, M. Popa and CALIXTO Group, 3-D upper crustal tomographic structure across the Vrancea seismic zone, Romania, *Tectonophysics*, **382**, 85-102, 2004.
10070	Campania, Italy	178/55	Amoruso, A., L. Crescentini and R. Scarpa, Faulting geometry for the complex 1980 Campania-Lucania earthquake from leveling data, *Geophys. J. Int.*, **162**, 156-158, 2005.
10090	Timisoara, Romania	75/0	Tóth, L., P. Mónus, M. Kiszely and Z. Kosztyu, Hungarian Earthquake Bulletin, 2000, *Georisk, Budapest*, 2001.
10091	Jordan River Valley, Israel	6/4	Feigin, G and A. Shapira, A unified crustal model for calculating travel times of seismic waves across the Israel Seismic Network, *IPRG Rep.*, Z1/567/79(107), 1994.
10092	Dead Sea, Israel	9/9	Feigin, G and A. Shapira, A unified crustal model for calculating travel times of seismic waves across the Israel Seismic Network, *IPRG Rep.*, Z1/567/79(107), 1994.
10093	Gulf of Aqaba, Egypt	50/0	Sweeney, J.J., Relocation of Gulf of Aqaba earthquakes using the JSOP bulletin, *Proc. 19th Seismic Research Symposium*, 310-319, Orlando, FL, September 23-25, 1997.

10108	Sarria-Becerrea, Spain	115/112	López-Fernández, C., J.A. Pulgar, J.M. Glez-Cortina, J. Gallart, J. Díaz and M. Ruiz, Actividad sísmica en el noroeste de la Península Ibérica observada por la red sísmica local del Proyecto GASPI (1999-2002), *Trabajos de Geología*, Univ. de Oviedo, **24**, 91-106, 2004.
10116	Terceira, Azores Islands	28/0	Kennett, B. L. N., E.R. Engdahl and R.P. Buland, Constraints on seismic velocities in the Earth from travel times, *Geophys. J. Int*., **122**, 108-124, 1995.
10118	Saõ Miguel, Azores Islands	11/0	Kennett, B. L. N., E.R. Engdahl and R.P. Buland, Constraints on seismic velocities in the Earth from travel times, *Geophys. J. Int*., **122**, 108-124, 1995.
10123	Rogun, Tajikistan	24/17	Hamburger, M.W., W.A. Swanson II and G.A. Popandopulo, Velocity structure and seismicity of the Garm region, Central Asia, *Geophys. J. Int.,* **115**, 497-511, 1993.
10126	Alipur, Pakistan	16/6	Mukhopadhyay, S. and J.R. Kayal, Seismic tomography structure of the 1999 Chamoli earthquake source area in the Garhwal Himalaya, *Bull. Seism. Soc. Am.*, **93**, 1854-1861, 2003.
10127	New Delhi, India	16/0	ak135
10132	Galwa, Nepal	53/0	Mukhopadhyay, S. and J.R. Kayal, Seismic tomography structure of the 1999 Chamoli earthquake source area in the Garhwal Himalaya, *Bull. Seism. Soc. Am.*, **93**, 1854-1861, 2003.
10133	Carletonville, South Africa	76/71	Simon, R.E., C. Wright, E.M. Kgaswane and M.T.O. Kwadiba, The P wavespeed structure below and around the Kaapvaal craton to depth 800 km, from traveltimes and waveforms of local and regional earthquakes and mining-induced tremors, *Geophys. J. Int*., **151**, 132-145, 2002.
10134	Welkom, South Africa	152/78	Simon, R.E., C. Wright, E.M. Kgaswane and M.T.O. Kwadiba, The P wavespeed structure below and around the Kaapvaal craton to depth 800 km, from traveltimes and waveforms of local and regional earthquakes and mining-induced tremors, *Geophys. J. Int*., **151**, 132-145, 2002.
10137	Rabaul, New Britain, Papua New Guinea	28/0	Abers, G.A. and S.W. Roecker, Deep structure of an arc-continent collision: Earthquake relocation and inversion for upper mantle P and S wave velocities beneath Papua New Guinea, *J. Geophys. Res*., **96**, 6379-6401, 1991.
10140	Lae, Papua New Guinea	67/28	Abers, G.A. and S.W. Roecker, Deep structure of an arc-continent collision: Earthquake relocation and inversion for upper mantle P and S wave velocities beneath Papua New Guinea, *J. Geophys. Res*., **96**, 6379-6401, 1991.
10143	Mt. St. Elias, SE Alaska	76/72	Fogleman, K.A., J.C. Lahr, C.D. Stephens and R.A. Page, Earthquake locations determined by the Southern Alaska Seismograph network for October 1971 through May 1989, *USGS Open-File Report 93-309*, 1993.
10158	Klutina Lake, S Alaska	139/137	Fogleman, K.A., J.C. Lahr, C.D. Stephens and R.A. Page, Earthquake locations determined by the Southern Alaska Seismograph network for October 1971 through May 1989, *USGS Open-File Report 93-309*, 1993.
10206	Klamath Falls, Oregon	36/0	Braunmiller, J., J. Nabelek, B. Leitner and A. Qamar, The 1993 Klamath Falls, Oregon, earthquake sequence: Source mechanisms from regional data, *Geophys. Res. Let.*, **22**, 105-108, 1995.
10220	Luzon, Philippines	34/0	ak135
10227	Okinawa, Ryukyu, Japan	4/0	Kennett, B. L. N., E.R. Engdahl and R.P. Buland, Constraints on seismic velocities in the Earth from travel times, *Geophys. J. Int*., **122**, 108-124, 1995.
10235	Kumamoto, Kyushu	17/17	Smith, A.J., P.R. Cummins, T. Baba, S. Kodaira, Y. Kaneda and H. Yamaguchi, Intra-plate seismicity in the subducting Philippine Sea Plate, southwest Japan: magnitude-depth correlations, *Phys. Earth Planet. Int.*, **145**, 179-202, 2004.
10246	Owase, W Honshu	16/14	ak135
10251	Kyoto, Honshu	19/19	Fuyukama, E., W.E. Ellsworth, F. Waldhauser and A. Kubo,

			Detailed fault structure of the Western Tottori, Japan, earthquake sequence, *Bull. Seism. Soc. Am.*, **93**, 1468-1478, 2003.
10263	Miyakejima, Izu-Bonin	116/116	Klein, F.W., A linear gradient crustal model for south Hawaii, *Bull. Seism. Soc. Am.*, **71**, 1503-1510, 1981.
10279	Tottori, Honshu	13/12	Fuyukama, E., W.E. Ellsworth, F. Waldhauser and A. Kubo, Detailed fault structure of the Western Tottori, Japan, earthquake sequence, *Bull. Seism. Soc. Am.*, **93**, 1468-1478, 2003.
10293	Bali	12/0	ak135
10303	Acapulco, Guerrero, Mexico	43/19	Valdes-Gonzalez, C. and R.P. Meyer, Seismic structure between the Pacific coast and Mexico City from the Petatlan earthquake (Ms=7.6) aftershocks, *Geofisica Internacional*, **35**, Oct-Dec, 1996.
10309	San Vicente, El Salvador	21/3	Vallée, M., M. Bouchon and S.Y. Schwartz, The 13 January 2001 El Salvador earthquake: A multidata analysis, *J. Geophys. Res*., **108**, B4, doi:10.1029/2002JB001922, 2003.
10310	Gulf of Fonseca, Honduras	17/0	ak135
10313	Cerro Negro, Nicaragua	14/11	Instituto Nicaragüense de Estudios Territoriales, http://www.ineter.gob.ni/geofisica/geofisica.html
10319	San Marcos, Costa Rica	26/9	Yao, Z.S., R. Quintero and R.G. Roberts, Tomographic imaging of P and S-wave velocity structure beneath Costa Rica, *J. Seism*., **3**, 177-190, 1999.
10324	Amatitlan, Guatemala	11/3	Ligorría J.P. and E. Molina, Crustal velocity structure of Southern Guatemala using refracted and Sp converted waves, *Geofísica Intern*., **36**, 1, 1997.
10329	Quito, Ecuador	6/0	Ojeda, A., and J. Havskov, Crustal structure and local seismicity in Colombia, *J. Seismology*, **5**, 575-593, 2001.
10330	Ambato, Ecuador	26/5	Ojeda, A., and J. Havskov, Crustal structure and local seismicity in Colombia, *J. Seismology*, **5**, 575-593, 2001.
10342	Redonda, Leeward Islands	15/13	Rowe, C.A., C.H. Thurber and R.A. White, Dome growth behavior at Soufriere Hills Volcano, Montserrat, revealed by relocation of volcanic event swarms, 1995-1996, *J. Volc. Geotherm. Res.*, **134**, 199-221, 2004.
10344	Tobago, Windward Islands	25/20	Rowe, C.A., C.H. Thurber and R.A. White, Dome growth behavior at Soufriere Hills Volcano, Montserrat, revealed by relocation of volcanic event swarms, 1995-1996, *J. Volc. Geotherm. Res.*, **134**, 199-221, 2004.
10346	Gulf of Paria, Venezuela	31/0	Bosch, M., P wave velocity tomography of the Venezuelan region from local arrival times, *J. Geophys. Res*., **102**, B3, 5455-5472, 1997.
10361	Puente Alto, Chile	14/11	Alvarado, P., S. Beck, G. Zandt, M. Araujo and E. Triep, Crustal deformation in the south-central Andes backarc terranes as viewed from regional broad-band seismic waveform modeling, *Geophys. J. Int.*, **163**, 580-598, 2005.
10362	San Juan, Argentina	36/3	Regnier, M., J-M. Chiu, R. Smalley, B.L. Sacks and M. Araujo, Crustal thickness variation in the Andean foreland, Argentina, from converted waves, *Bull. Seism. Soc. Am.*, **84**, 1097-1111, 1994.
10367	Lake Tekapo, New Zealand	18/14	Matcham, I., M.K. Savage, J.J. Taber and M. Reyners, Earthquake source mechanism analysis for events between 1992 and 1997 using sparse New Zealand broadband data, *New Zealand J. Geol. Geophys*., **49**, 75-89, 2006.
10369	Inangahua, New Zealand	51/27	Eberhart-Phillips, D. and M. Reyners, Continental subduction and three-dimensional crustal structure: The northern South Island, New Zealand, *J. Geophys. Res.,* **102** B6, 11,843-11,861, 1997.
10370	Arthur's Pass, New Zealand	55/52	Matcham, I., M.K. Savage, J.J. Taber and M. Reyners, Earthquake source mechanism analysis for events between 1992 and 1997 using sparse New Zealand broadband data, *New Zealand J. Geol. Geophys*., **49**, 75-89, 2006.
10371	Lake Tennyson, New Zealand	59/53	McGinty, P., R. Robinson, J. Taber and M. Reyners, The 1990 Lake Tennyson earthquake sequence, Marlborough, New Zealand, *N.Z. J. Geol. Geophys*., **40**, 521-535, 1997.

10378	Wellington, New Zealand	18/17	Eberhart-Phillips, D. and M. Reyners, Continental subduction and three-dimensional crustal structure: The northern South Island, New Zealand, *J. Geophys. Res.,* **102** B6, 11,843-11,861, 1997.
10381	Rotorua, New Zealand	22/19	Sherburn, S., S. Bannister and H. Bibby, Seismic velocity structure of the central Taupo Volcanic Zone, New Zealand, from local earthquake tomography, *J. Volc. Geotherm. Res.*, **122**, 69-88, 2003.
10386	Kileaua South Flank, Hawaii	104/56	Klein, F.W., A linear gradient crustal model for south Hawaii, *Bull. Seism. Soc. Am.*, **71**, 1503-1510, 1981.
10500	Spitak, Armenia	33/24	Simpson, D. E. Cranswick, M. Andrews and G. Glassmoyer, Preliminary aftershock locations (December 21, 1988 – January 4, 1989), in: *Results and data from seismologic and geologic studies following earthquakes of December 7, 1988, near Spitak, Armenia S.S.R*., ed: R.G. Borcherdt, USGS Open-File Report 89-163A, 1989
10501	Racha, Georgia	81/58	Fuenzalida, H., L. Rivera, H. Haessler, D. Legrand, H. Philip, L. Dorbath, D. McCormack, S. Arefiev, C. Langer and A. Cisternas, Seismic source study of the Racha-Dzhava (Georgia) earthquake from aftershocks and broad-band teleseismic body-wave records: an example of active nappe tectonics, *Geophys. J. Int*., **130**, 29-46, 1997.
10502	Izmit, Turkey	107/88	Karabulut, H., M-P. Bouin, M. Bouchon, M. Dietrich, C. Cornou and M. Aktar, The seismicity in the Eastern Marmara Sea after the 17 August 1999 Izmit earthquake, *Bull. Seism. Soc. Am.*, **92**, 387-393, 2002.
10503	Duzce, Turkey	69/45	Karabulut, H., M-P. Bouin, M. Bouchon, M. Dietrich, C. Cornou and M. Aktar, The seismicity in the Eastern Marmara Sea after the 17 August 1999 Izmit earthquake, *Bull. Seism. Soc. Am.*, **92**, 387-393, 2002.
10504	Adana, Turkey	35/20	Ergin, M. M. Aktar and H. Eyidogan, Present-day seismicity and seismotectonics of the Cilician Basin: Eastern Mediterranean region of Turkey, *Bull. Seism. Soc. Am.*, **94**, 930-939, 2004.
10505	Bhuj, India	32/31	Mandal, P. and S. Horton, Relocation of aftershocks, focal mechanisms and stress inversion: Implications toward the seismo-tectonics of the causative fault zone of Mw 7.6 Bhuj earthquake (India), *Tectonophysics*, **429**, 61-78, 2007.
10506	Koyna, India	35/0	Rastogi, B.K., R.K. Chadha, C.S.P. Parma, P. Mandal, H.V.S. Satyanarayana, I.P. Raju, N. Kumar, C. Satyamurthy and N. Rao, Seismicity at Warna reservoir (near Koyna) through 1995, *Bull. Seism. Soc. Am.*, **87**, 1484-1494, 1997.
10507	Chamoli, India	53/39	Mukhopadhyay, S. and J.R. Kayal, Seismic tomography structure of the 1999 Chamoli earthquake source area in the Garhwal Himalaya, *Bull. Seism. Soc. Am.*, **93**, 1854-1861, 2003.
10509	Al-Hoceima, Morocco	94/80	Stich, D., F. Mancilla, D. Baumnot and J. Morales, Source analysis of the Mw 6.3 2004 Al Hoceima earthquake using regional apparent source time functions, *J. Geophys. Res*., **110**, B06306, doi:10.1029/2004JB003366, 2005.
10510	Aldan River, Southern Yakutsk, Russia	8/7	Mackey, K.G. and K. Fujita, Seismicity characterization and velocity structure of Northeast Russia, *Defense Threat Reduction Agency*, Technical Report DTRA-TR-02-5, 2005.
10511	Avaj, Iran	11/0	Personal communication, IIEES, 2005.
10512	Erzincan, Turkey	30/0	Kaypak, B., and H. Eyidogan, One-dimensional crustal structure of the Erzincan basin, Eastern Turkey and relocations of the 1992 Erzincan earthquake (Ms-6.8) aftershock sequence, *Phys. Earth Planet. Int.*, **151**, 1-20, 2005.
10520	Meckering, Australia	14/9	Vogfjörd, K.S. and C.A. Langston, The Meckering earthquake of 14 October 1968: A possible downward propagating rupture, *Bull. Seism. Soc. Am.*, **77**, 1558-1578, 1987.
10521	Stilfontein, South Africa	84/71	Simon, R.E., C. Wright, E.M. Kgaswane and M.T.O. Kwadiba, The P wavespeed structure below and around the Kaapvaal craton to depth 800 km, from traveltimes and waveforms of local

			and regional earthquakes and mining-induced tremors, *Geophys. J. Int.*, **151**, 132-145, 2002.
10522	Johannesburg, South Africa	60/48	Simon, R.E., C. Wright, E.M. Kgaswane and M.T.O. Kwadiba, The P wavespeed structure below and around the Kaapvaal craton to depth 800 km, from traveltimes and waveforms of local and regional earthquakes and mining-induced tremors, *Geophys. J. Int.*, **151**, 132-145, 2002.
10523	Armenia, Colombia	9/0	Ojeda, A., and J. Havskov, Crustal structure and local seismicity in Colombia, *J. Seismology*, **5**, 575-593, 2001.
10524	Dowling, Mexico	12/12	Ritsema, J. and T. Lay, Long-period regional wave moment tensor inversion for earthquakes in the western United States, *J. Geophys. Res.*, **100**, 9853-9864, 1995.
10525	Hidalgo, Mexico	22/20	Ritsema, J. and T. Lay, Long-period regional wave moment tensor inversion for earthquakes in the western United States, *J. Geophys. Res.*, **100**, 9853-9864, 1995.
10526	Monchique, Portugal	6/6	Seismological Bulletin from the IGIDL Seismic Network, *Geophys. Inst. Infante D. Luiz, Univ. Lisbon*, 2007.
10527	Cheneville, Canada	22/21	Ma, S., and G.M. Atkinson, Focal depths for small to moderate earthquakes (mN ≥2.8) in Western Quebec, Southern Ontario and Northern New York, *Bull. Seism. Soc. Am.*, **96**, 609-623, 2006.
10528	Charlevoix, Canada	38/36	Ma, S., and G.M. Atkinson, Focal depths for small to moderate earthquakes (mN ≥2.8) in Western Quebec, Southern Ontario and Northern New York, *Bull. Seism. Soc. Am.*, **96**, 609-623, 2006.
10529	Manzat, France	29/29	Zeyen, H., O. Novak, M. Landes, C. Prodehl, L. Driad and A. Hirn, Refraction-seismic investigations of the northern Massif Central (France), *Tectonophysics*, **275**, 99-117, 1997.
10530	Wadgassen, Germany	63/63	ak135
10531	Bernov, Czech Republic	75/75	Hrubcova, P., P. Sroda, A. Spicak, A. Guterch, M. Grad, G.R. keller, E. Bueckl and H. Thybo, Crustal and uppermost mantle structure of the Bohemian Massif based on CELEBRATION 2000 data, *J. Geophys. Res.*, **110**, B11305, 2005.
10532	Cieszyn, Poland	48/48	Majdanski, M., M. Grad, A. Guterch, SUDETES 2003 Working Group, 2-D seismic tomographic and ray tracing modeling of the crustal structure across the Sudetes Mountains basing on SUDETES 2003 experiment data, *Tectonophysics*, **413**, 294-269, 2006.
10533	Baikal Lake, Russia	30/0	Radziminovitch, N., J. Déverchère, V. Melnikova, V. Sankov and N. Giljova, The 1999 Mw 6.0 earthquake sequence in the southern Baikal rift, Asia, and its seismotectonic implications, *Geophys. J. Int.,* **161**, 387-400, 2005.
10540	Simeulue, Sumatra	33/32	Personal communication, F. Tilmann, 2007.
10541	Puerto Rico	31/13	Fischer, K.M and W.R. McCann, Velocity modeling and earthquake relocation in the Northeast Caribbean, *Bull. Seism. Soc. Am.*, **74**, 1249-1262, 1984.
10999	Dorud, Iran	65/59	Personal communication, IIEES, 2005.

Appendix B.

Table 3. GT5 or better events produced by HDC-RCA

Date	Time	Lat	Lon	Depth	Smajax	Sminax	Strike
Scotty's Junction, CA							
1992/07/19	00:32:39.602	37.157	-117.320	5.0	3.85	2.64	38.12
1992/07/29	22:24:08.867	37.128	-117.351	5.0	4.25	3.08	41.99
1998/04/04	08:01:24.598	37.510	-117.219	5.0	3.55	2.61	68.39
1999/08/01	04:17:14.171	37.392	-117.049	5.0	2.89	2.20	45.24
1999/08/01	14:56:41.246	37.400	-117.054	5.0	2.94	2.23	47.33
1999/08/01	16:06:23.355	37.417	-117.063	5.0	2.95	2.23	46.75
1999/08/01	16:11:21.391	37.408	-117.045	5.0	2.92	2.21	46.37
1999/08/01	16:26:46.469	37.385	-117.055	5.0	2.92	2.20	46.09
1999/08/01	16:27:17.355	37.377	-117.047	5.0	2.98	2.25	48.76
1999/08/01	16:46:46.574	37.395	-117.043	5.0	3.06	2.30	52.87
1999/08/01	17:15:49.953	37.443	-117.103	5.0	3.16	2.30	54.51
1999/08/01	17:47:44.773	37.389	-117.051	5.0	2.97	2.26	50.66
1999/08/01	18:26:00.086	37.399	-117.044	5.0	2.94	2.24	47.30
1999/08/01	23:38:55.563	37.386	-117.057	5.0	2.92	2.21	46.33
1999/08/02	05:40:26.398	37.381	-117.058	5.0	2.93	2.24	47.37
1999/08/02	06:05:13.615	37.399	-117.051	5.0	2.91	2.21	46.04
1999/08/06	05:28:34.238	37.393	-117.069	5.0	3.00	2.29	52.06
1999/08/07	17:14:43.359	37.442	-117.129	5.0	3.25	2.29	54.89
1999/09/26	16:15:37.617	37.361	-117.054	5.0	3.37	2.49	46.40
1999/09/26	20:11:21.727	37.378	-117.054	5.0	3.14	2.25	51.54
1999/10/20	10:15:03.234	37.357	-117.107	5.0	3.02	2.35	53.21
2000/06/06	05:32:18.986	37.361	-117.186	5.0	3.18	2.46	62.69
2000/10/14	04:53:28.436	37.375	-117.082	5.0	3.75	2.80	41.65
2000/12/24	18:19:00.328	37.390	-117.126	5.0	3.28	2.60	47.52
2000/12/24	20:52:46.305	37.447	-117.112	5.0	3.19	2.51	47.54
2001/01/18	15:12:34.805	37.367	-117.137	5.0	3.11	2.32	52.22
2002/02/19	07:32:23.373	37.367	-117.056	5.0	3.53	3.13	45.36
2002/11/25	00:03:10.242	37.390	-117.181	5.0	2.92	2.23	45.49
2002/11/25	07:51:17.070	37.392	-117.177	5.0	3.02	2.30	46.10
2003/04/06	02:18:10.887	37.383	-117.085	5.0	2.98	2.26	49.12
2004/08/10	14:17:18.648	37.448	-117.131	5.0	3.21	2.32	56.49
Gulf of Tadjoura,							
1983/09/28	21:02:35.192	11.546	42.984	14.7	4.83	3.94	149.75
1994/04/11	11:20:21.348	11.822	42.888	14.7	4.97	3.84	134.13
1994/04/24	02:57:12.646	11.711	42.957	14.7	4.76	3.76	141.35
Velingrad, Bulgaria							
1977/11/03	02:22:56.830	42.083	24.034	7.5	3.79	2.90	44.74
1977/11/06	02:48:45.153	42.065	24.081	7.5	3.83	2.90	42.11
1977/11/17	06:28:09.988	42.043	24.003	7.5	4.35	3.32	46.47

1978/01/05	08:03:48.930	42.037	23.964	7.5	4.33	2.98	54.09
1978/06/27	12:18:23.234	42.053	24.065	7.5	3.75	2.90	51.85
1979/12/03	20:00:57.313	42.244	23.850	7.5	4.39	3.96	98.03
1983/09/10	18:40:22.422	42.219	23.656	7.5	4.70	3.16	57.84
1988/08/18	17:37:45.473	42.121	23.926	7.5	4.66	3.07	56.26
Kozani-Grevena, Greece							
1984/04/04	17:23:56.324	40.029	21.632	6.5	2.34	2.20	62.50
1984/10/25	14:49:14.715	40.094	21.648	5.3	2.33	1.78	11.06
1987/02/19	22:41:21.656	40.204	21.478	2.2	2.66	2.04	13.13
1994/09/07	02:10:43.600	40.166	21.641	4.8	2.75	2.04	8.61
1995/05/13	09:18:39.852	40.202	21.631	5.0	4.45	3.57	174.83
1995/05/13	09:55:25.473	40.126	21.602	5.0	3.47	2.47	24.12
1995/05/13	10:11:57.039	40.109	21.705	5.0	2.76	1.96	3.25
1995/05/13	10:58:34.383	40.109	21.574	5.0	2.18	1.77	26.62
1995/05/13	11:05:59.203	40.082	21.632	5.0	2.69	2.12	3.40
1995/05/13	13:41:49.234	40.123	21.759	5.0	4.35	3.16	101.41
1995/05/13	14:16:29.547	40.119	21.639	6.9	2.25	1.88	10.94
1995/05/13	15:25:41.953	40.083	21.567	3.8	3.02	2.78	172.91
1995/05/13	16:38:35.328	40.159	21.674	5.0	2.97	2.64	12.16
1995/05/13	17:54:53.520	40.005	21.743	7.3	2.42	1.90	8.31
1995/05/13	18:06:00.383	40.143	21.671	12.5	1.87	1.56	15.25
1995/05/13	18:35:38.195	40.134	21.562	2.1	2.74	2.48	171.35
1995/05/13	18:46:29.055	40.149	21.671	12.5	2.77	2.17	179.54
1995/05/13	23:27:56.461	40.124	21.677	9.1	2.46	2.09	162.22
1995/05/13	23:53:41.891	40.027	21.597	2.3	2.14	1.83	14.27
1995/05/13	23:56:25.977	40.037	21.624	2.5	2.05	1.66	3.36
1995/05/14	01:02:58.693	40.121	21.557	7.5	1.94	1.68	13.41
1995/05/14	02:38:56.472	40.109	21.565	9.9	2.13	1.80	11.66
1995/05/14	02:46:59.055	40.086	21.587	5.0	1.72	1.49	4.72
1995/05/14	02:53:18.970	40.152	21.703	2.5	2.93	2.59	160.00
1995/05/14	03:02:27.399	40.056	21.564	7.5	2.17	1.79	5.36
1995/05/14	03:09:37.644	40.098	21.612	10.0	1.79	1.54	10.64
1995/05/14	04:29:23.602	40.190	21.699	6.6	2.84	2.15	1.42
1995/05/14	05:14:52.471	40.105	21.593	5.0	2.16	1.78	11.24
1995/05/14	05:59:15.641	40.042	21.574	2.5	2.00	1.66	5.58
1995/05/14	06:27:07.217	39.986	21.455	5.6	2.32	1.95	12.61
1995/05/14	07:30:09.418	40.122	21.638	10.0	2.35	1.93	14.43
1995/05/14	08:35:11.102	40.126	21.551	10.0	2.23	1.70	10.66
1995/05/14	18:32:02.625	40.183	21.721	11.4	2.43	2.01	8.73
1995/05/15	01:20:14.757	40.115	21.546	5.3	1.96	1.66	9.36
1995/05/15	04:13:56.437	40.083	21.643	12.5	1.73	1.50	16.29
1995/05/15	06:42:27.895	40.122	21.601	10.0	3.45	2.47	1.80

1995/05/15	07:22:06.854	40.100	21.643	10.0	1.93	1.74	30.43
1995/05/15	08:16:59.963	40.105	21.491	12.5	2.22	1.77	2.91
1995/05/15	09:19:44.090	40.137	21.533	12.5	2.02	1.71	9.46
1995/05/15	11:42:56.695	40.076	21.681	12.5	3.10	2.38	14.38
1995/05/15	12:03:40.855	40.155	21.536	12.5	2.51	1.97	2.39
1995/05/15	16:18:35.527	40.151	21.703	12.9	2.67	2.26	2.49
1995/05/15	22:10:11.187	40.164	21.694	12.5	3.14	2.51	170.46
1995/05/15	22:47:33.547	40.157	21.653	12.5	2.11	1.77	0.80
1995/05/16	05:04:13.684	40.051	21.664	10.2	2.16	1.96	158.58
1995/05/16	17:57:50.770	40.076	21.628	3.5	1.83	1.64	172.26
1995/05/16	23:00:41.477	40.017	21.610	8.2	1.80	1.56	5.63
1995/05/16	23:57:27.563	40.097	21.640	10.0	1.68	1.47	0.91
1995/05/17	03:54:53.499	40.090	21.642	10.0	1.87	1.75	6.59
1995/05/17	04:14:25.285	40.082	21.641	10.0	1.59	1.40	5.95
1995/05/17	04:48:34.783	40.078	21.620	9.8	1.71	1.59	176.75
1995/05/17	09:45:07.785	40.010	21.586	5.0	1.70	1.50	8.86
1995/05/17	11:30:19.266	40.038	21.609	2.5	2.90	2.82	104.37
1995/05/17	15:37:59.777	40.051	21.621	2.5	2.09	1.83	175.57
1995/05/17	23:51:47.289	40.023	21.646	2.5	1.98	1.74	175.86
1995/05/18	03:49:01.401	40.080	21.641	12.9	1.97	1.67	6.43
1995/05/19	06:48:49.631	40.068	21.631	2.5	1.63	1.44	8.77
1995/05/19	07:36:49.074	40.072	21.659	2.5	2.80	2.37	172.90
1995/05/19	07:43:46.422	40.096	21.589	7.5	4.28	3.04	81.27
1995/05/19	12:29:52.500	40.072	21.764	2.1	2.43	1.98	167.17
1995/05/20	20:09:30.695	39.989	21.606	3.1	1.97	1.58	176.87
1995/05/22	21:10:33.188	39.997	21.616	5.0	2.19	1.90	1.25
1995/05/22	22:30:40.703	40.086	21.715	6.1	1.84	1.58	175.52
1995/05/23	04:37:39.732	40.097	21.575	5.0	1.78	1.50	175.86
1995/05/23	20:09:53.039	39.996	21.588	3.0	1.92	1.64	1.81
1995/05/23	20:59:49.930	39.984	21.587	5.0	2.02	1.68	179.42
1995/05/24	05:22:43.283	40.094	21.608	5.0	1.89	1.65	1.27
1995/05/24	06:24:08.543	39.980	21.613	5.0	2.20	1.83	172.90
1995/05/24	08:30:26.760	40.140	21.541	7.5	2.84	2.33	174.01
1995/05/25	08:30:24.842	39.962	21.576	5.0	3.20	2.25	165.59
1995/05/25	08:48:54.049	40.108	21.722	5.0	2.35	2.03	149.96
1995/05/30	06:21:06.313	40.123	21.546	3.4	2.42	2.05	179.61
1995/05/30	06:46:01.074	40.143	21.543	8.5	2.39	2.00	9.32
1995/05/30	12:06:42.203	40.061	21.688	2.5	1.85	1.53	173.64
1995/05/30	14:30:01.891	40.004	21.622	5.4	1.88	1.58	176.45
1995/06/02	07:47:15.084	40.063	21.604	2.8	2.89	2.04	1.05
1995/06/03	10:20:14.773	40.156	21.612	11.8	2.06	1.80	174.48
1995/06/06	00:46:51.854	40.177	21.680	5.0	2.24	1.81	5.11

1995/06/06	04:35:58.807	40.152	21.648	7.5	1.74	1.51	173.07
1995/06/07	08:37:34.305	40.151	21.628	6.0	2.00	1.64	177.65
1995/06/09	15:20:47.789	40.156	21.637	2.4	2.12	1.68	2.52
1995/06/11	18:51:46.969	39.965	21.616	5.0	1.76	1.53	179.45
1995/06/11	20:38:21.703	39.995	21.601	5.0	2.28	1.82	159.91
1995/06/17	17:48:08.211	40.136	21.724	5.0	2.37	1.78	179.68
1995/06/18	17:28:08.082	39.975	21.456	4.7	2.05	1.73	162.68
1995/06/19	04:41:31.080	40.160	21.689	3.2	1.96	1.67	2.06
1995/06/19	07:07:02.855	40.143	21.679	2.9	2.59	2.17	16.68
1995/07/09	06:22:07.363	40.159	21.649	4.6	3.60	2.84	66.84
1995/07/11	00:18:01.113	40.134	21.624	2.6	2.33	1.98	10.82
1995/07/17	23:18:15.609	40.125	21.583	12.5	1.56	1.39	171.51
1995/07/18	03:09:07.314	40.123	21.585	7.6	1.84	1.57	8.49
1995/07/18	05:05:32.674	40.120	21.611	6.8	2.04	1.77	22.82
1995/07/18	07:42:53.699	40.118	21.644	5.0	1.90	1.61	167.35
1995/07/18	20:19:08.266	40.117	21.595	4.0	1.88	1.64	179.02
1995/07/19	18:23:14.789	40.118	21.652	12.5	1.71	1.49	178.53
1995/07/28	22:43:29.664	40.155	21.652	4.9	1.73	1.55	0.00
1995/07/30	09:28:10.383	40.094	21.727	7.5	1.82	1.65	142.82
1995/09/14	01:26:38.962	40.161	21.556	2.5	1.94	1.71	7.63
1995/10/30	01:53:11.192	40.043	21.632	2.5	1.82	1.65	177.42
1995/11/13	13:40:32.777	40.079	21.776	2.5	2.19	1.88	9.21
1995/12/02	06:12:35.012	40.126	21.551	2.4	2.27	1.97	4.96
1996/02/05	05:42:22.762	40.115	21.655	1.8	2.52	2.17	158.64
1996/03/24	23:11:20.125	40.099	21.600	5.0	1.95	1.76	6.17
1996/07/10	00:02:22.236	40.098	21.499	2.5	2.46	1.88	177.85
1996/10/10	19:07:47.047	40.163	21.525	5.0	2.22	1.77	9.95
1997/02/13	20:10:21.445	40.166	21.689	10.0	1.90	1.57	21.54
1997/08/19	19:03:47.898	40.093	21.660	10.0	1.88	1.68	12.73
1997/08/22	03:09:41.440	40.156	21.627	10.0	1.90	1.70	0.07
1997/08/22	03:17:46.610	40.143	21.592	10.0	1.77	1.55	18.15
1998/06/20	11:40:24.715	40.099	21.697	10.0	1.90	1.69	32.47
2003/06/11	17:13:01.828	40.178	21.652	3.2	2.31	1.68	10.41
Nisyros, Greece							
1968/10/31	03:22:16.631	36.681	27.061	10.0	4.64	4.02	48.25
1968/11/12	03:37:37.785	36.758	27.138	15.0	4.85	4.13	50.98
1968/12/05	07:52:09.061	36.607	26.995	10.0	4.50	3.89	44.99
1968/12/21	00:36:38.175	36.656	27.097	10.0	4.98	4.40	45.05
1996/07/23	15:17:57.355	36.679	27.148	10.0	4.52	3.85	44.75
1996/07/24	00:43:22.129	36.697	27.195	15.0	4.30	3.66	45.29
1996/07/24	08:02:52.084	36.700	27.153	15.0	4.34	3.72	43.00
1997/08/27	03:50:26.065	36.619	27.126	10.0	4.64	3.86	47.11

1997/08/27	06:56:36.326	36.629	27.145	10.0	4.91	4.04	55.46
1997/09/21	16:25:23.402	36.725	27.230	10.0	4.87	3.95	62.03
1997/12/27	19:17:53.656	36.673	27.200	10.0	4.45	3.69	46.03
1997/12/27	19:45:20.805	36.668	27.236	10.0	4.81	4.07	52.44
Oren, Turkey							
1976/01/10	07:11:17.738	36.874	27.868	14.5	4.86	3.04	85.72
1982/06/07	00:31:25.800	36.930	27.867	14.5	4.51	2.95	87.43
1984/02/06	04:03:25.775	37.098	28.049	14.5	4.59	2.87	85.89
1989/02/19	14:28:46.929	37.024	28.085	14.5	4.51	2.91	86.90
1989/04/27	23:06:52.199	37.036	28.086	14.5	4.42	2.83	87.79
1989/04/28	01:18:49.249	37.045	28.025	14.5	4.93	3.08	85.49
1989/04/28	13:30:19.093	37.026	28.066	14.5	4.42	2.88	87.50
1989/05/10	22:23:36.667	37.030	28.024	14.5	4.71	2.96	87.21
1989/06/24	15:01:24.648	37.011	28.021	14.5	4.54	2.96	85.64
2002/03/01	21:09:32.144	37.111	27.908	14.5	4.71	3.02	84.00
2004/08/03	11:53:07.371	36.880	27.731	14.5	4.68	3.19	84.84
2004/08/03	13:11:31.839	36.917	27.728	14.5	4.41	2.83	88.21
2004/08/04	04:19:47.896	36.890	27.740	14.5	4.41	2.84	88.05
2004/08/04	05:46:13.585	36.942	27.765	14.5	4.56	3.03	84.73
2004/08/05	07:13:36.755	36.944	27.739	14.5	4.52	2.97	87.11
2004/08/05	10:30:06.597	36.948	27.749	14.5	4.53	2.93	86.28
Denizli, Turkey							
1965/06/13	20:01:48.383	37.897	29.314	7.5	4.31	3.32	150.88
1965/06/17	02:58:21.911	37.834	29.377	7.5	4.55	3.38	155.15
1976/08/19	01:12:38.626	37.813	29.010	7.5	3.90	3.27	132.02
1984/05/04	21:35:02.336	37.934	29.237	7.5	3.94	3.22	137.00
1989/02/24	00:40:34.873	37.722	29.305	7.5	3.74	3.01	132.99
1989/02/24	01:17:43.692	37.690	29.300	7.5	3.81	3.17	129.15
1989/02/24	12:30:10.805	37.699	29.258	7.5	3.79	3.06	130.48
1996/06/22	16:05:34.117	37.851	29.409	7.5	4.21	3.47	129.14
1997/06/16	15:00:42.379	37.896	29.189	7.5	4.70	3.29	128.93
2000/04/21	12:23:08.402	37.888	29.370	7.5	3.71	2.97	132.27
2000/04/21	12:29:11.848	37.866	29.333	7.5	4.23	3.58	125.74
2000/06/07	00:05:07.462	37.826	29.131	7.5	4.96	3.22	131.98
2000/10/04	02:33:58.013	37.894	29.093	7.5	3.75	2.99	133.15
2000/10/06	09:59:01.793	37.948	29.047	7.5	4.42	3.43	131.22
2000/11/26	17:08:34.898	37.939	29.003	7.5	3.86	3.11	135.86
2000/11/26	17:20:37.059	37.936	29.001	7.5	3.82	3.12	135.01
2002/07/30	12:20:24.051	37.677	29.283	7.5	3.72	2.98	132.11
Vrancea, Romania							
1969/12/21	19:06:23.681	45.574	26.879	24.7	4.81	3.35	71.68
1975/03/02	13:21:17.947	45.533	26.999	24.7	4.65	3.33	91.26

1975/03/07	04:13:07.320	45.870	26.610	24.7	2.59	2.50	9.12
1979/06/07	21:20:37.743	45.813	27.401	24.7	4.80	3.37	85.17
1981/02/16	23:27:25.884	45.664	27.245	24.7	3.19	2.68	104.50
1983/02/21	18:03:57.177	45.318	26.917	24.7	2.76	2.60	125.72
1983/02/21	18:09:24.353	45.331	26.938	24.7	3.66	2.90	112.12
1983/05/03	20:05:12.368	45.398	27.012	24.7	3.37	2.71	105.78
1984/05/14	19:14:45.361	45.158	26.900	24.7	2.74	2.56	138.52
1986/04/27	00:04:33.701	45.542	26.981	24.7	2.40	2.29	6.67
1987/08/30	06:07:13.494	45.754	27.115	24.7	4.68	3.17	170.54
1990/10/14	13:17:38.533	45.970	26.945	24.7	2.93	2.63	32.08
1991/08/31	22:43:17.736	45.455	27.021	24.7	3.90	3.19	145.76
1991/09/01	01:16:03.320	45.515	26.880	24.7	2.42	2.33	5.64
1991/09/01	02:18:01.420	45.452	26.992	24.7	3.20	2.93	138.77
1991/09/01	13:21:31.931	45.484	26.944	24.7	3.62	2.66	107.07
1992/07/12	20:23:15.189	45.646	27.044	24.7	3.08	2.74	83.42
1996/06/11	21:45:06.994	45.618	27.383	24.7	2.78	2.60	131.19
1997/12/06	12:17:24.783	45.602	27.088	24.7	4.22	3.11	109.53
2004/04/30	09:19:36.732	45.543	27.042	24.7	3.14	2.74	71.84
Campania, Italy							
1980/11/24	21:15:52.648	40.645	15.581	5.0	2.52	2.41	78.26
1980/11/25	13:22:57.922	40.711	15.396	5.0	3.55	2.72	92.32
1980/11/25	18:28:22.086	40.585	15.449	5.0	1.79	1.64	48.28
1980/11/26	10:47:54.324	40.814	15.432	5.0	2.93	2.15	91.80
1981/01/15	11:12:43.281	40.720	15.372	5.0	2.05	1.68	51.34
1981/01/16	00:37:46.846	40.841	15.308	5.0	1.78	1.56	46.51
1981/01/16	04:36:51.748	40.802	15.317	5.0	2.87	2.43	35.66
1981/01/16	06:31:26.566	40.852	15.321	5.0	3.42	2.70	62.87
1981/01/17	03:04:00.579	40.698	15.432	5.0	2.55	2.12	63.74
1981/01/20	08:55:05.961	40.652	15.363	5.0	2.64	2.11	41.50
1981/01/22	14:41:22.867	40.748	15.331	5.0	3.10	2.29	46.21
1981/02/03	18:32:09.805	40.683	15.482	5.0	4.99	3.49	14.52
1981/02/11	12:44:55.824	40.810	15.104	5.0	4.18	3.00	63.52
1981/02/15	17:22:26.258	40.549	15.657	5.0	3.24	2.54	69.08
1981/02/27	03:37:32.784	40.680	15.466	5.0	3.68	2.92	74.37
1981/04/15	03:08:43.327	40.691	15.313	5.0	3.37	2.83	53.96
1981/09/21	16:12:30.973	40.618	15.715	5.0	3.63	2.16	26.46
1982/08/28	05:24:02.998	40.774	15.365	5.0	3.09	2.37	56.78
1983/10/18	23:46:37.891	40.640	15.548	5.0	3.06	2.95	46.38
1984/01/05	12:39:40.531	40.097	15.700	5.0	2.31	2.01	65.73
1988/01/12	23:01:00.445	40.265	15.489	5.0	1.91	1.70	44.68
1988/10/18	20:33:24.367	40.480	15.812	5.0	3.29	2.82	91.28
1989/04/21	19:28:51.516	40.519	15.876	5.0	4.22	3.90	139.79

1989/05/21	06:47:41.008	40.455	15.677	5.0	4.45	2.63	67.06
1989/05/29	11:19:11.613	40.552	15.757	5.0	1.80	1.64	61.35
1990/05/05	07:21:18.813	40.681	15.883	5.0	1.69	1.51	41.06
1990/05/05	07:33:57.902	40.644	15.795	5.0	3.96	3.37	89.08
1990/05/05	07:38:12.934	40.677	15.832	5.0	1.82	1.58	43.40
1990/05/05	07:59:34.500	40.664	15.786	5.0	3.09	1.82	76.39
1990/05/05	08:03:49.293	40.685	15.896	5.0	2.71	2.59	98.52
1990/05/05	08:41:05.227	40.676	15.834	5.0	2.87	2.17	65.46
1990/05/05	08:58:46.309	40.679	15.772	5.0	2.93	2.02	72.33
1990/05/05	19:59:59.516	40.637	15.760	5.0	2.30	1.85	70.68
1990/05/06	04:00:33.409	40.661	15.865	5.0	2.45	1.79	71.19
1990/05/06	05:43:28.109	40.686	15.734	5.0	2.32	1.98	55.92
1990/07/16	15:09:04.945	40.668	15.742	5.0	4.52	2.75	34.72
1990/08/26	13:41:26.191	40.449	15.730	5.0	2.05	1.89	41.28
1990/08/28	19:02:53.063	40.701	15.943	5.0	2.41	1.80	30.24
1990/09/20	20:06:07.406	40.683	15.841	5.0	2.05	1.74	59.09
1991/05/05	17:16:55.902	40.218	15.992	5.0	2.16	1.84	51.20
1991/05/26	12:26:01.305	40.672	15.780	5.0	1.70	1.49	36.64
1992/05/08	02:11:32.912	40.657	15.792	5.0	1.98	1.75	43.86
1993/04/05	22:55:33.289	40.672	15.770	5.0	2.44	1.94	34.70
1993/06/03	22:17:34.297	40.590	15.767	5.0	3.85	2.66	144.84
1994/11/12	21:35:32.633	40.438	15.806	5.0	2.30	1.69	61.26
1995/02/01	12:45:35.801	40.807	15.366	5.0	2.94	2.26	58.91
1999/04/05	07:51:57.787	40.766	15.359	5.0	1.98	1.69	63.77
2000/05/18	02:45:50.405	40.832	15.329	5.0	2.60	1.87	42.81
2000/05/19	07:56:00.152	40.830	15.356	5.0	3.82	3.07	23.95
2001/12/09	12:15:08.945	40.763	15.317	5.0	2.30	1.79	55.35
2002/04/18	20:56:48.789	40.605	15.557	5.0	1.83	1.60	47.45
2002/04/21	23:39:49.875	40.558	15.557	5.0	3.86	2.45	72.71
2003/02/03	11:24:41.207	40.760	15.652	5.0	2.90	2.84	178.28
2004/02/23	19:48:45.469	40.700	15.452	5.0	2.05	1.64	51.80
2004/02/24	05:21:26.434	40.707	15.467	5.0	1.72	1.53	54.35
Jordan River Valley, Israel							
1988/05/07	20:17:35.869	32.830	35.638	12.6	4.90	3.15	99.26
1988/05/13	22:48:43.447	33.149	35.610	12.6	4.93	3.19	101.60
1998/12/15	11:17:01.080	32.790	35.616	12.6	4.85	3.16	99.11
1999/04/11	19:45:05.377	33.204	35.555	12.6	4.84	3.13	97.50
Dead Sea, Israel							
1984/11/05	01:15:25.556	32.124	35.350	5.0	3.71	3.11	85.91
1985/01/25	06:08:03.402	31.920	35.524	16.5	3.85	2.59	96.91
1993/08/02	09:12:56.863	31.506	35.424	21.3	4.27	2.41	95.46
1994/09/16	03:18:57.411	32.038	35.519	21.8	4.35	2.54	92.54

1999/11/08	13:00:01.031	31.538	35.409	0.1	3.49	2.19	100.94
1999/11/10	13:59:58.746	31.536	35.423	0.1	3.16	2.10	101.37
1999/11/11	15:00:01.316	31.535	35.429	0.1	3.28	2.13	100.98
2004/02/11	08:15:04.162	31.711	35.417	23.8	3.74	2.27	94.97
2004/07/07	14:35:09.402	31.997	35.490	20.0	3.46	2.20	96.66
Sarria-Becerrea, Spain							
1979/01/16	00:55:15.741	42.792	-7.019	13.5	4.60	2.03	165.25
1979/12/18	05:47:33.677	42.765	-7.154	13.5	4.86	2.28	170.44
1995/11/29	23:56:28.798	42.806	-7.271	13.5	1.70	1.48	78.80
1995/11/30	00:09:25.795	42.795	-7.227	13.5	3.06	1.80	109.31
1995/11/30	01:03:02.697	42.807	-7.233	13.5	2.04	1.70	102.11
1995/11/30	01:32:29.983	42.810	-7.251	13.5	2.16	1.87	97.90
1995/11/30	01:45:39.353	42.812	-7.255	13.5	2.06	1.68	104.52
1995/11/30	02:20:33.950	42.811	-7.283	13.5	1.81	1.54	93.69
1995/11/30	02:45:06.017	42.806	-7.256	13.5	1.97	1.65	104.30
1995/11/30	04:23:57.657	42.816	-7.242	13.5	2.03	1.66	104.93
1995/11/30	15:49:18.396	42.808	-7.258	13.5	2.38	2.04	71.92
1995/11/30	22:16:55.634	42.818	-7.248	13.5	2.03	1.69	98.19
1995/12/01	05:48:59.488	42.819	-7.228	13.5	3.34	1.90	49.87
1995/12/01	07:20:01.458	42.808	-7.247	13.5	2.01	1.75	98.20
1995/12/01	09:52:11.060	42.835	-7.209	13.5	3.71	2.18	47.80
1995/12/24	11:28:23.904	42.813	-7.247	13.5	2.07	1.74	110.39
1995/12/24	14:29:20.818	42.825	-7.293	13.5	1.72	1.46	85.24
1995/12/24	15:02:01.279	42.795	-7.252	13.5	2.19	1.96	35.71
1995/12/24	15:49:42.728	42.804	-7.246	13.5	2.12	1.80	118.26
1995/12/24	16:25:13.790	42.795	-7.241	13.5	1.98	1.82	126.12
1995/12/24	18:19:52.907	42.803	-7.256	13.5	1.75	1.55	89.44
1996/04/04	16:26:24.126	42.811	-7.236	13.5	1.79	1.51	89.75
1996/04/15	20:28:07.954	42.813	-7.243	13.5	2.03	1.69	95.81
1996/10/29	21:34:50.876	42.822	-7.227	13.5	2.13	1.76	103.07
1997/01/29	01:58:48.441	42.796	-7.238	13.5	2.45	2.11	90.57
1997/02/03	22:09:56.697	42.809	-7.238	13.5	2.02	1.54	99.28
1997/02/04	13:45:08.614	42.817	-7.240	13.5	1.80	1.58	92.72
1997/03/19	05:04:35.249	42.822	-7.250	13.5	2.29	2.04	68.67
1997/05/15	20:28:03.712	42.806	-7.233	13.5	2.39	2.14	69.62
1997/05/21	23:49:44.571	42.808	-7.275	13.5	1.70	1.41	85.52
1997/05/21	23:50:44.017	42.829	-7.278	13.5	1.73	1.47	85.57
1997/05/22	00:02:52.642	42.725	-7.321	13.5	2.30	1.69	104.21
1997/05/22	00:10:21.886	42.803	-7.174	13.5	3.26	2.37	158.84
1997/05/22	00:14:08.293	42.794	-7.209	13.5	3.16	2.44	150.12
1997/05/22	00:16:23.085	42.782	-7.228	13.5	2.42	2.23	172.04
1997/05/22	00:17:18.763	42.787	-7.260	13.5	1.73	1.62	70.73

1997/05/22	00:28:36.016	42.781	-7.202	13.5	2.23	2.07	118.56
1997/05/22	00:41:26.837	42.822	-7.220	13.5	2.07	1.69	95.80
1997/05/22	00:45:41.768	42.824	-7.228	13.5	2.66	2.34	143.24
1997/05/22	01:32:35.707	42.809	-7.238	13.5	1.88	1.65	86.58
1997/05/22	01:41:14.671	42.801	-7.230	13.5	2.15	1.96	135.27
1997/05/22	02:03:57.250	42.789	-7.183	13.5	2.95	2.50	147.66
1997/05/22	02:23:36.561	42.761	-7.221	13.5	4.24	2.67	33.40
1997/05/22	02:34:29.693	42.814	-7.244	13.5	2.02	1.89	128.02
1997/05/22	02:37:58.745	42.784	-7.210	13.5	2.25	1.98	155.70
1997/05/22	02:40:11.547	42.788	-7.228	13.5	2.74	2.38	140.78
1997/05/22	02:51:21.771	42.794	-7.207	13.5	2.00	1.94	137.10
1997/05/22	03:02:58.440	42.794	-7.225	13.5	2.04	1.72	97.29
1997/05/22	03:26:21.094	42.808	-7.159	13.5	4.35	3.00	44.27
1997/05/22	03:28:48.977	42.784	-7.207	13.5	2.48	2.05	129.37
1997/05/22	03:58:54.953	42.781	-7.232	13.5	1.85	1.79	84.54
1997/05/22	04:03:48.679	42.805	-7.216	13.5	2.26	2.07	142.20
1997/05/22	05:06:52.021	42.790	-7.226	13.5	1.78	1.50	88.07
1997/05/22	14:09:48.083	42.793	-7.212	13.5	1.92	1.86	94.95
1997/05/22	14:41:15.431	42.782	-7.227	13.5	2.80	2.57	48.14
1997/05/22	16:52:57.587	42.785	-7.202	13.5	2.69	2.51	12.57
1997/05/22	17:05:27.079	42.788	-7.185	13.5	2.72	2.36	152.95
1997/05/22	18:17:39.431	42.791	-7.196	13.5	2.54	2.38	22.13
1997/05/22	18:31:10.509	42.812	-7.192	13.5	2.61	2.42	12.20
1997/05/22	19:03:43.868	42.805	-7.162	13.5	3.58	3.05	25.94
1997/05/22	22:56:27.329	42.821	-7.230	13.5	2.22	1.99	135.95
1997/05/23	00:39:10.231	42.813	-7.245	13.5	1.89	1.67	89.50
1997/05/23	00:57:38.947	42.807	-7.235	13.5	1.97	1.93	35.60
1997/05/23	13:30:43.521	42.790	-7.198	13.5	2.01	1.95	94.40
1997/05/23	18:14:41.712	42.792	-7.210	13.5	1.69	1.44	84.87
1997/05/24	18:33:31.454	42.832	-7.210	13.5	2.40	2.19	97.98
1997/05/24	18:42:28.228	42.815	-7.226	13.5	1.89	1.60	91.64
1997/05/25	00:36:56.415	42.782	-7.179	13.5	1.94	1.62	92.82
1997/05/25	17:21:53.685	42.804	-7.234	13.5	1.91	1.61	89.45
1997/05/27	06:19:41.695	42.778	-7.215	13.5	4.24	2.44	52.63
1997/05/29	22:22:56.798	42.759	-7.247	13.5	3.98	2.04	47.37
1997/05/30	01:49:23.690	42.793	-7.212	13.5	2.04	1.75	85.08
1997/05/30	07:49:22.657	42.797	-7.250	13.5	1.93	1.63	91.03
1997/05/30	20:48:28.181	42.790	-7.221	13.5	2.61	2.24	141.86
1997/06/04	20:28:10.181	42.805	-7.199	13.5	2.43	2.15	83.79
1997/06/28	10:59:09.704	42.798	-7.233	13.5	2.29	1.85	97.79
1997/11/18	18:24:56.126	42.795	-7.195	13.5	2.00	1.66	101.69
1998/03/31	00:01:23.598	42.795	-7.232	13.5	1.73	1.46	88.60

1998/04/24	16:05:32.161	42.808	-7.233	13.5	1.93	1.61	94.93
1998/05/15	15:16:47.626	42.785	-7.242	13.5	2.99	1.75	108.60
1998/07/17	08:29:05.429	42.795	-7.222	13.5	2.00	1.60	103.34
1998/07/17	09:35:54.681	42.809	-7.239	13.5	2.12	1.90	79.18
1998/08/30	22:55:10.915	42.786	-7.255	13.5	2.26	1.81	105.93
1998/11/11	23:03:42.782	42.793	-7.234	13.5	4.83	2.80	45.16
1998/11/17	04:08:21.483	42.782	-7.148	13.5	4.19	3.28	93.43
1999/06/20	04:44:13.443	42.804	-7.250	13.5	1.90	1.63	95.27
1999/08/01	05:08:25.394	42.788	-7.221	13.5	1.99	1.66	103.45
1999/08/01	05:10:38.456	42.807	-7.202	13.5	2.54	2.01	74.88
1999/08/01	06:11:52.382	42.798	-7.227	13.5	2.85	2.01	55.79
1999/09/11	19:13:45.392	42.780	-7.258	13.5	3.37	2.19	97.15
2000/01/30	15:03:06.513	42.794	-7.233	13.5	2.20	1.81	105.91
2000/02/25	02:02:35.576	42.796	-7.241	13.5	3.91	2.43	43.89
2001/01/05	12:00:29.728	42.804	-7.230	13.5	2.06	1.74	94.09
2001/01/05	12:05:50.415	42.756	-7.303	13.5	4.02	2.34	46.94
2001/01/12	21:48:26.431	42.805	-7.256	13.5	3.44	1.93	47.93
2001/04/09	23:58:53.353	42.791	-7.229	13.5	2.21	1.86	95.36
2001/04/09	23:59:07.236	42.789	-7.200	13.5	2.32	2.10	123.68
2001/04/09	23:59:41.150	42.785	-7.224	13.5	3.20	2.26	157.37
2001/04/10	00:00:36.324	42.776	-7.208	13.5	2.48	2.18	90.53
2001/04/10	00:37:39.426	42.787	-7.211	13.5	1.87	1.61	90.35
2001/07/26	09:50:58.743	42.736	-7.083	13.5	1.99	1.68	91.55
2001/08/27	08:08:30.280	42.846	-7.229	13.5	2.23	2.19	5.45
2001/12/06	20:47:23.931	42.776	-7.241	13.5	2.02	1.59	84.82
2002/08/18	05:53:07.001	42.705	-7.244	13.5	1.96	1.66	82.17
2003/04/21	18:59:51.556	42.810	-7.217	13.5	1.96	1.89	113.12
2003/12/27	07:00:59.249	42.800	-7.216	13.5	2.02	1.67	104.54
2003/12/27	07:09:34.822	42.802	-7.220	13.5	1.97	1.68	95.14
2004/06/09	06:11:04.452	42.797	-7.233	13.5	2.22	1.66	81.81
2004/07/18	15:49:06.747	42.789	-7.209	13.5	2.03	1.57	79.21
2004/07/18	15:52:50.517	42.792	-7.198	13.5	2.19	1.65	80.22
2004/07/18	16:10:46.611	42.789	-7.195	13.5	1.96	1.52	79.06
2004/07/29	04:42:01.876	42.786	-7.188	13.5	2.45	1.81	97.00
Rogun, Tajikistan							
1969/03/22	04:52:34.486	38.944	70.529	10.0	4.44	3.06	139.25
1969/09/20	14:07:54.445	38.506	69.594	10.0	4.42	3.18	136.01
1970/12/08	11:53:14.676	38.833	70.210	10.0	4.82	3.28	132.09
1971/10/01	16:27:46.324	38.707	69.803	10.0	4.51	3.19	134.83
1972/11/27	15:18:44.469	38.474	69.582	10.0	4.37	3.31	142.49
1974/12/08	06:51:48.809	38.698	69.985	10.0	4.49	3.12	140.07
1985/12/15	06:32:51.779	38.896	69.837	10.0	4.36	3.06	140.22

1985/12/15	23:28:28.195	38.894	69.752	10.0	4.60	3.23	140.05
1986/02/22	11:17:40.109	38.828	69.875	10.0	4.61	3.11	141.13
1992/01/04	14:12:29.762	39.029	69.836	10.0	4.52	3.33	140.59
1992/11/08	20:50:08.453	38.654	69.796	15.0	4.36	3.13	144.87
1993/06/27	08:31:18.621	38.685	69.761	15.0	4.28	3.10	143.02
1993/10/02	01:17:31.840	39.077	69.991	15.0	4.39	3.20	145.05
1996/10/14	12:24:17.770	38.878	69.824	25.0	4.52	4.17	127.21
1998/06/14	14:12:05.883	38.764	70.257	10.0	4.64	3.72	132.94
2002/01/09	06:45:56.896	38.739	69.834	15.0	4.22	2.95	142.17
2002/02/03	20:59:26.859	38.752	69.876	25.0	4.25	3.00	143.07
Alipur, Pakistan							
1977/02/14	00:22:36.802	33.571	73.199	10.0	4.91	3.72	55.63
1978/05/07	10:32:26.559	33.386	73.566	20.0	4.94	3.68	56.93
1987/07/12	12:19:19.297	33.432	73.317	11.3	4.94	3.66	57.01
1996/03/25	06:31:21.947	33.175	73.419	10.0	4.89	3.60	55.21
1999/04/28	13:00:48.305	33.247	73.213	10.7	4.81	3.54	55.76
2001/07/16	16:07:19.023	32.931	73.055	45.0	4.92	3.59	53.81
Carletonville, South Africa							
1981/05/21	15:40:30.656	-26.367	27.462	5.0	3.18	2.53	121.60
1981/07/07	12:52:41.898	-26.386	27.437	5.0	2.87	2.10	95.62
1982/04/27	23:23:13.836	-26.358	27.379	5.0	3.46	2.72	108.07
1982/06/26	08:45:39.973	-26.390	27.451	5.0	3.13	2.45	118.52
1982/07/26	06:02:56.758	-26.407	27.418	5.0	3.33	2.75	135.18
1982/07/30	08:58:49.975	-26.403	27.414	5.0	3.50	2.81	128.04
1982/08/23	15:29:39.207	-26.361	27.367	5.0	3.38	2.91	120.71
1982/10/13	23:22:26.953	-26.338	27.353	5.0	3.60	2.71	99.18
1983/05/16	15:44:22.645	-26.387	27.440	5.0	3.74	2.70	108.39
1984/03/16	22:05:31.383	-26.426	27.465	5.0	2.95	2.17	109.56
1984/08/18	00:08:52.349	-26.394	27.428	5.0	4.87	2.44	116.28
1985/01/08	19:37:07.555	-26.410	27.374	5.0	4.36	3.10	87.05
1985/03/29	00:53:14.108	-26.423	27.377	5.0	3.30	2.57	121.94
1985/08/29	06:58:16.664	-26.421	27.391	5.0	4.52	2.59	112.15
1985/10/17	08:43:51.100	-26.401	27.452	5.0	3.02	2.22	109.37
1986/05/02	15:08:38.570	-26.420	27.403	5.0	4.82	2.60	130.12
1986/06/08	16:10:07.535	-26.441	27.355	5.0	3.04	2.18	117.05
1986/07/02	04:00:24.400	-26.395	27.462	5.0	3.24	2.12	111.81
1986/08/20	11:49:32.996	-26.392	27.435	5.0	3.04	2.22	101.51
1986/10/10	10:28:55.750	-26.404	27.373	5.0	3.47	2.52	93.28
1986/10/14	06:17:04.893	-26.405	27.591	5.0	4.07	2.44	108.17
1986/10/14	11:16:26.855	-26.439	27.381	5.0	3.42	2.29	94.12
1986/11/03	16:40:23.277	-26.398	27.475	5.0	3.03	2.33	104.64
1986/12/18	06:20:55.340	-26.397	27.342	5.0	3.70	2.64	103.35

1986/12/21	10:52:00.039	-26.370	27.540	5.0	4.53	2.56	113.32
1986/12/29	20:42:01.078	-26.374	27.531	5.0	3.51	2.28	110.29
1987/08/02	21:44:52.172	-26.365	27.593	5.0	3.56	2.24	104.08
1987/09/18	03:18:13.995	-26.388	27.315	5.0	3.87	2.94	100.72
1987/10/02	13:44:36.727	-26.373	27.466	5.0	4.29	2.36	106.40
1988/02/19	15:44:31.754	-26.437	27.390	5.0	3.73	3.18	109.93
1988/06/06	16:54:51.656	-26.425	27.361	5.0	3.27	2.32	97.71
1989/01/06	23:16:49.938	-26.374	27.477	5.0	2.85	2.26	102.98
1989/03/19	14:53:39.609	-26.394	27.439	5.0	3.49	2.29	89.74
1990/02/14	15:55:04.922	-26.387	27.423	5.0	3.57	2.68	126.90
1991/04/18	15:28:30.102	-26.360	27.522	5.0	2.57	1.87	124.49
1991/07/18	15:38:45.477	-26.422	27.477	5.0	3.96	2.46	101.60
1991/07/22	14:37:20.418	-26.350	27.461	5.0	3.52	2.70	99.52
1991/07/28	23:45:58.250	-26.412	27.457	5.0	3.26	2.35	102.71
1991/07/29	07:10:33.477	-26.435	27.394	5.0	3.41	2.54	98.57
1991/08/01	12:58:24.910	-26.395	27.495	5.0	3.23	2.40	99.68
1991/08/28	20:36:41.672	-26.411	27.430	5.0	2.85	2.29	130.16
1991/10/11	06:11:29.574	-26.346	27.519	5.0	4.00	2.53	99.38
1991/11/29	11:14:12.996	-26.392	27.382	5.0	3.54	2.55	96.08
1992/03/11	18:00:31.453	-26.446	27.405	5.0	3.13	2.35	136.53
1992/06/21	02:25:41.467	-26.443	27.383	5.0	3.56	2.32	89.11
1992/06/25	03:29:29.639	-26.413	27.383	5.0	3.51	2.64	91.44
1992/07/03	08:20:43.957	-26.423	27.459	5.0	3.46	2.62	95.84
1992/07/13	16:35:56.992	-26.372	27.526	5.0	4.06	2.71	103.94
1992/08/07	06:34:31.381	-26.393	27.541	5.0	3.28	2.23	103.98
1992/10/17	14:06:39.441	-26.421	27.441	5.0	3.34	2.49	110.48
1992/12/15	16:40:51.996	-26.413	27.420	5.0	3.15	2.26	98.91
1992/12/23	12:49:15.977	-26.423	27.457	5.0	3.97	2.41	107.98
1993/02/23	05:12:46.137	-26.386	27.474	5.0	3.21	2.46	101.25
1993/04/06	17:23:48.812	-26.398	27.483	5.0	3.38	2.48	93.54
1993/04/14	08:05:51.561	-26.379	27.370	5.0	3.60	2.38	103.90
1993/05/10	17:28:24.969	-26.386	27.449	5.0	3.14	2.14	87.07
1993/05/26	16:46:51.926	-26.400	27.549	5.0	3.46	2.39	94.63
1994/04/06	13:28:36.828	-26.357	27.519	5.0	3.23	2.33	128.50
1994/06/01	22:27:50.016	-26.466	27.448	5.0	3.39	1.72	121.84
1994/09/29	16:33:11.789	-26.440	27.381	5.0	2.76	2.15	103.97
1995/06/30	16:58:30.844	-26.388	27.418	5.0	3.92	1.77	117.50
1995/08/11	11:53:00.945	-26.435	27.448	5.0	3.41	1.88	121.72
1995/09/02	18:40:33.766	-26.385	27.525	5.0	3.13	1.99	107.09
1995/10/06	16:13:44.336	-26.424	27.460	5.0	2.89	1.93	125.59
1995/11/24	15:38:26.004	-26.417	27.454	5.0	3.16	1.75	122.31
1995/11/27	17:46:30.305	-26.411	27.380	5.0	2.86	1.66	119.69

1995/12/28	10:47:26.090	-26.426	27.453	5.0	3.97	2.31	129.13
1996/06/23	21:14:35.883	-26.425	27.376	5.0	2.73	1.73	116.03
1998/10/02	07:35:30.707	-26.420	27.392	5.0	3.83	2.17	96.07
2000/06/16	19:13:36.734	-26.436	27.421	5.0	2.56	1.69	98.80
2000/07/08	22:11:11.367	-26.435	27.423	5.0	2.44	1.63	102.82
Welkom, South Africa							
1983/03/14	00:14:48.678	-28.041	26.856	7.4	2.88	2.11	118.33
1983/05/24	13:09:57.106	-28.010	26.827	7.4	3.47	2.54	120.28
1983/06/10	15:25:02.813	-27.988	26.789	7.4	3.49	2.53	74.90
1983/07/20	07:35:10.909	-27.986	26.800	7.4	3.41	2.40	120.60
1983/08/21	14:08:07.618	-28.121	26.999	7.4	3.13	2.28	124.83
1984/04/07	21:42:46.419	-28.064	26.901	7.4	3.07	2.41	124.49
1984/04/18	12:48:40.040	-28.058	26.939	7.4	2.99	2.75	72.49
1984/05/11	17:46:36.794	-28.029	26.821	7.4	3.14	2.48	76.34
1984/06/20	04:49:36.927	-28.089	26.903	7.4	2.64	2.05	119.65
1984/11/07	10:30:40.231	-28.047	26.816	7.4	2.69	2.02	118.86
1985/06/29	06:16:57.606	-28.044	26.860	7.4	3.33	2.33	121.50
1985/10/02	00:33:24.225	-28.039	26.790	7.4	3.82	2.92	62.22
1985/12/03	22:07:33.935	-28.045	26.926	7.4	3.20	2.64	135.04
1985/12/09	12:20:19.462	-27.982	26.827	7.4	3.18	2.29	115.84
1986/05/17	03:41:38.268	-28.080	26.916	7.4	3.04	2.25	122.68
1986/11/03	17:30:12.192	-28.072	26.875	7.4	3.11	2.45	133.71
1987/06/08	05:40:50.397	-28.012	26.786	7.4	3.42	2.73	121.60
1987/08/31	02:37:05.601	-28.061	26.840	7.4	4.66	2.73	57.55
1987/09/04	20:00:17.435	-27.986	26.835	7.4	4.50	3.57	67.40
1987/11/20	15:29:40.345	-27.987	26.789	7.4	3.64	3.13	69.09
1988/01/18	15:45:24.196	-27.948	26.768	7.4	4.19	3.05	49.33
1988/06/26	03:04:06.430	-27.973	26.798	7.4	3.42	2.64	68.60
1988/08/16	00:19:29.605	-28.143	26.926	7.4	3.93	2.75	139.36
1988/08/27	01:02:20.439	-28.000	26.876	7.4	4.00	3.87	70.40
1988/11/05	14:00:36.446	-28.017	26.819	7.4	3.45	2.58	137.49
1989/01/25	10:14:34.829	-27.955	26.797	7.4	2.50	2.11	46.62
1989/04/01	03:47:51.249	-28.016	26.783	7.4	3.80	2.92	52.25
1989/04/01	04:13:19.555	-28.086	26.786	7.4	3.70	2.82	123.11
1989/04/11	16:56:42.567	-28.009	26.828	7.4	3.11	2.89	34.74
1989/11/27	19:53:02.138	-28.066	26.835	7.4	3.90	3.34	44.22
1990/08/08	23:25:46.552	-28.082	26.973	7.4	3.81	2.85	138.01
1990/09/26	23:08:24.817	-28.058	26.834	7.4	3.34	2.05	110.97
1990/09/27	14:07:04.251	-28.101	26.919	7.4	4.02	2.65	147.01
1990/11/14	00:31:42.741	-28.084	26.894	7.4	3.24	2.69	138.11
1991/07/20	20:55:54.606	-27.987	26.802	7.4	3.17	2.84	35.22
1991/08/05	05:51:57.317	-28.097	26.910	7.4	4.37	3.73	15.12

1991/08/22	19:47:38.927	-27.970	26.722	7.4	4.51	3.24	140.49
1991/10/18	01:06:17.440	-28.032	26.896	7.4	4.18	3.10	127.08
1991/11/16	13:56:54.532	-28.045	26.712	7.4	2.87	2.21	122.38
1991/12/18	07:54:50.011	-28.021	26.864	7.4	3.18	2.68	129.61
1991/12/31	18:19:02.419	-27.982	26.867	7.4	3.24	2.69	130.30
1992/02/07	05:40:16.044	-28.129	26.915	7.4	4.29	3.64	6.33
1992/02/10	15:07:49.927	-28.023	26.746	7.4	3.79	2.75	134.13
1992/02/10	15:47:23.774	-28.014	26.740	7.4	2.51	2.24	120.29
1992/04/11	17:19:31.270	-28.134	26.867	7.4	4.04	2.40	146.67
1992/05/05	06:54:22.657	-28.040	26.816	7.4	3.03	2.41	135.89
1992/05/13	22:48:40.794	-27.826	26.658	7.4	3.47	2.90	68.72
1992/06/06	18:34:01.474	-28.008	26.905	7.4	2.50	2.31	125.58
1992/07/17	10:05:04.032	-28.067	26.866	7.4	3.35	2.55	131.32
1993/03/04	16:20:47.317	-27.980	26.792	7.4	2.89	2.46	56.25
1993/03/11	02:00:51.554	-28.046	26.809	7.4	3.98	2.92	136.35
1993/04/18	02:58:31.044	-28.083	26.903	7.4	3.36	2.53	142.76
1993/07/07	15:56:17.556	-28.104	26.864	7.4	3.44	2.17	147.06
1993/09/07	19:12:05.052	-28.151	26.921	7.4	3.44	2.46	141.91
1993/09/20	22:48:09.872	-28.070	26.908	7.4	3.01	2.33	137.43
1993/11/04	17:11:00.458	-27.859	26.728	7.4	3.12	2.44	167.93
1993/11/18	14:21:25.727	-27.905	26.788	7.4	3.22	2.66	69.31
1994/06/27	04:11:22.847	-27.979	26.802	7.4	2.94	2.71	118.61
1994/07/07	20:32:56.372	-27.986	26.820	7.4	3.07	2.36	149.50
1994/10/30	06:06:28.786	-28.035	26.799	7.4	1.96	1.80	102.06
1994/11/01	13:12:45.563	-27.987	26.772	7.4	4.42	3.40	28.26
1994/11/11	17:16:05.286	-27.943	26.754	7.4	3.46	2.76	57.25
1994/11/17	14:15:15.524	-27.949	26.753	7.4	4.04	3.10	29.49
1994/11/19	22:59:02.895	-27.970	26.693	7.4	4.39	3.04	148.10
1995/05/19	05:48:52.013	-28.044	26.804	7.4	3.91	2.94	148.62
1995/07/04	06:38:14.847	-27.939	26.731	7.4	3.28	2.86	134.06
1995/11/11	21:47:14.474	-27.939	26.780	7.4	2.71	2.43	14.48
1995/12/17	22:31:32.302	-27.916	26.698	7.4	2.46	2.27	98.89
1996/01/16	22:45:43.411	-27.963	26.754	7.4	4.02	3.34	15.97
1996/02/06	12:46:03.708	-27.890	26.788	7.4	2.96	2.59	3.33
1996/08/22	18:25:57.724	-27.904	26.785	7.4	3.03	2.57	167.02
1996/12/11	12:50:09.306	-27.923	26.805	7.4	3.21	2.39	112.79
1997/07/29	11:25:06.235	-27.984	26.755	7.4	2.34	2.13	17.22
1997/08/01	02:17:27.300	-27.964	26.701	7.4	3.37	2.19	108.72
1998/09/16	07:03:01.056	-28.103	26.951	7.4	2.85	2.59	80.27
1998/12/01	18:12:17.106	-28.013	26.791	7.4	3.25	2.84	94.94
1999/04/22	22:19:38.310	-27.922	26.768	7.4	2.45	2.24	101.98
2000/07/29	00:04:35.406	-27.912	26.713	7.4	4.47	2.53	114.68

Lae, Papua New Guinea							
1967/05/04	13:32:44.027	-6.020	146.543	35.0	4.39	4.03	141.38
1967/05/04	16:22:01.852	-6.005	146.526	35.0	3.65	3.51	66.01
1967/05/05	14:02:42.594	-5.958	146.516	35.0	3.92	3.35	60.78
1983/11/29	22:18:31.563	-6.246	146.549	31.7	3.42	2.44	58.14
1987/03/18	21:29:24.945	-5.917	146.228	35.0	4.13	3.43	46.85
1991/06/08	14:52:32.148	-5.997	146.622	38.3	4.37	2.83	76.63
1993/10/13	05:50:43.738	-6.030	146.166	32.4	3.59	2.51	63.06
1993/10/13	22:46:30.750	-6.043	146.062	15.0	4.09	2.97	67.47
1993/10/13	23:37:59.852	-5.970	146.072	20.0	4.95	3.19	74.90
1993/10/15	00:11:37.792	-6.062	146.145	20.0	4.44	2.84	68.13
1993/10/16	03:45:41.008	-5.899	146.343	35.0	4.59	3.07	74.76
1993/10/25	10:07:12.887	-5.916	145.987	18.0	3.28	2.38	60.45
1993/10/25	11:59:47.535	-5.940	146.017	15.0	4.88	3.30	66.85
1993/10/25	12:18:01.828	-5.972	146.021	13.1	4.32	3.00	55.65
1993/10/28	06:01:29.484	-5.830	146.056	15.0	4.58	4.03	88.14
1993/11/01	05:01:54.998	-5.819	146.183	17.6	3.42	2.64	61.61
1993/11/01	07:44:52.926	-5.820	146.119	20.0	3.69	2.88	57.67
1993/11/07	07:35:00.311	-5.852	146.174	15.0	3.88	2.90	54.22
1993/11/07	14:04:57.348	-5.937	146.172	15.0	4.98	3.15	47.47
1996/08/07	14:39:56.156	-6.006	146.213	15.0	4.48	3.32	90.07
1996/09/21	01:23:34.191	-6.202	146.208	5.0	3.53	2.77	65.32
1996/09/21	21:18:41.023	-6.301	146.310	5.0	4.13	3.11	47.27
1996/09/21	21:35:23.242	-6.207	146.333	5.0	4.38	3.21	70.73
1996/09/21	22:38:52.164	-6.196	146.294	5.0	4.08	2.64	62.90
1996/09/26	15:29:04.805	-6.206	146.240	5.0	3.97	2.63	58.93
1996/10/03	03:31:08.492	-6.207	146.311	5.0	4.96	3.76	56.75
1998/01/16	10:23:36.762	-5.910	146.462	28.6	3.45	2.44	63.39
1999/02/22	18:10:08.523	-6.133	146.200	30.0	4.56	3.80	105.92
Mt. St. Elias, Alaska							
1965/06/27	11:08:56.312	60.193	-141.090	2.4	4.40	2.76	49.34
1967/11/27	04:27:03.494	60.246	-140.767	12.6	3.99	2.43	43.42
1972/09/29	09:00:38.474	60.190	-140.973	17.4	4.06	3.03	21.11
1979/03/01	01:37:49.568	60.254	-140.692	21.0	3.60	2.34	12.47
1979/03/01	02:48:45.952	60.245	-140.722	18.5	3.19	2.12	14.38
1979/04/20	12:49:08.397	60.217	-140.833	14.9	2.67	1.81	26.28
1979/05/16	14:19:20.179	60.245	-140.961	4.9	2.98	2.04	30.06
1979/05/19	18:05:24.538	60.243	-140.988	4.9	3.12	2.05	27.75
1979/06/17	17:58:20.503	60.186	-141.030	4.9	4.08	2.31	35.25
1979/10/17	23:34:09.022	60.054	-140.874	4.9	4.15	2.27	31.70
1980/06/30	18:07:39.921	60.020	-141.047	5.5	2.69	1.73	15.82
1980/06/30	18:47:49.507	59.987	-141.041	4.9	3.50	2.21	20.94

1980/06/30	18:59:32.155	60.003	-140.998	7.3	3.01	1.88	25.30
1980/07/18	20:12:05.132	60.228	-141.200	4.9	3.27	2.08	27.67
1980/10/06	23:33:32.155	60.033	-141.179	4.8	4.02	2.65	21.19
1981/10/16	14:43:22.218	60.219	-140.963	7.4	3.43	2.04	13.34
1982/04/23	14:43:17.862	60.150	-141.048	4.9	2.49	1.64	20.67
1982/05/02	15:35:59.593	60.061	-141.088	7.4	2.28	1.57	22.45
1982/05/02	16:11:58.136	60.078	-141.118	4.9	3.41	1.98	10.49
1982/05/02	16:24:52.089	60.060	-141.089	9.7	3.71	2.25	2.87
1982/05/02	17:00:27.925	60.079	-141.131	7.4	2.83	1.79	17.02
1982/05/02	17:13:38.487	60.072	-141.134	4.9	3.12	1.84	15.20
1982/05/03	10:14:15.499	60.094	-141.040	6.8	2.67	1.72	21.48
1982/05/03	15:17:27.206	60.040	-141.142	4.9	3.64	2.03	12.14
1982/05/04	05:28:54.022	60.058	-141.177	4.9	3.55	1.79	13.46
1982/05/15	19:51:02.812	60.035	-141.194	7.4	3.71	2.13	13.31
1982/10/17	18:50:01.351	60.091	-140.953	12.4	4.71	2.73	20.18
1984/02/12	04:48:02.692	60.245	-140.968	12.6	3.09	1.86	15.61
1984/04/12	14:23:59.815	60.392	-141.369	12.4	4.43	2.35	4.14
1984/05/17	05:48:29.063	60.223	-141.020	12.3	3.80	1.87	20.54
1984/05/19	03:44:55.657	60.172	-141.104	13.4	4.01	1.97	7.88
1985/08/02	13:41:44.132	60.167	-140.970	7.4	2.59	1.59	16.09
1985/08/31	06:58:38.296	60.145	-140.977	7.4	2.67	1.66	17.88
1985/09/15	00:40:29.138	60.223	-140.952	7.4	3.81	1.84	15.39
1986/08/20	22:47:29.663	60.255	-141.051	7.4	2.85	1.64	23.45
1986/11/09	02:17:00.627	60.167	-140.968	7.4	2.77	1.65	15.59
1986/12/21	17:45:20.921	60.122	-140.939	4.9	2.74	1.61	14.51
1988/12/26	23:32:34.780	60.151	-141.076	4.9	2.78	1.63	18.34
1989/08/06	13:17:45.745	60.045	-140.888	7.4	2.45	1.70	17.24
1989/08/06	15:14:48.276	59.964	-140.852	4.9	2.58	1.71	9.41
1990/05/05	23:45:33.452	60.062	-141.141	7.4	2.95	1.70	19.48
1990/05/07	07:13:11.476	60.056	-141.173	4.9	3.89	1.84	17.09
1990/06/10	19:42:47.460	60.209	-141.043	2.4	3.66	1.93	13.15
1991/06/14	19:31:35.132	60.149	-141.281	4.9	3.24	1.67	23.60
1991/11/04	10:19:46.253	60.264	-140.831	5.7	2.99	1.89	13.36
1991/11/22	17:20:33.733	60.239	-140.827	11.0	2.62	1.58	21.04
1992/10/23	14:43:27.030	59.999	-141.382	10.3	2.49	1.55	17.56
1992/12/18	01:57:20.796	60.002	-141.401	9.2	2.88	1.67	16.21
1993/08/26	11:46:16.960	60.007	-140.992	4.7	2.23	1.51	18.15
1993/08/26	11:52:18.202	59.998	-141.012	4.8	2.17	1.49	18.75
1993/08/27	01:15:59.159	59.993	-140.921	7.4	2.35	1.52	18.24
1993/08/27	01:28:33.183	59.999	-140.922	7.4	2.99	1.61	19.55
1993/08/27	05:11:17.077	60.002	-140.966	7.4	2.58	1.55	17.77
1995/07/04	08:13:19.665	60.309	-140.900	4.9	4.38	1.80	26.80

1995/07/23	15:27:35.542	60.280	-141.149	5.8	2.46	1.55	22.60
1995/11/21	12:30:06.323	60.183	-140.878	4.9	2.57	1.66	19.49
1995/11/21	19:00:44.413	60.182	-140.849	4.9	3.87	1.98	16.53
1996/08/04	02:52:49.935	60.013	-141.412	12.3	2.72	2.13	3.12
1996/08/20	22:44:49.944	60.019	-141.506	13.4	2.68	1.86	7.93
1996/10/16	17:33:18.284	60.210	-140.889	6.6	3.57	1.89	21.70
1997/05/14	06:32:05.399	60.150	-141.065	4.9	3.75	2.28	16.93
1997/06/09	09:11:31.519	60.137	-140.693	4.9	3.60	2.06	19.87
1997/06/27	07:10:59.360	60.188	-140.922	4.9	3.43	2.19	15.07
1997/08/26	13:46:11.597	59.947	-141.336	4.9	2.67	1.59	13.62
1998/01/11	06:27:55.515	60.247	-140.968	4.9	3.80	1.81	24.71
1998/01/16	01:39:05.826	60.243	-141.118	6.3	4.10	1.84	24.04
1999/02/21	03:33:22.983	60.300	-140.901	5.0	2.99	1.75	17.73
1999/07/22	11:09:27.425	60.213	-141.013	4.6	2.30	1.54	24.89
1999/10/26	20:27:34.538	60.237	-140.948	2.4	3.91	2.30	8.82
2002/09/10	01:10:43.367	60.182	-141.069	2.8	3.40	1.73	23.96
2003/10/31	06:32:30.519	60.164	-141.059	3.7	2.66	1.62	27.91
2004/06/15	05:58:09.124	60.297	-141.172	10.0	2.55	1.59	29.19
Klutina Lake, Alaska							
1970/07/10	09:16:45.809	61.488	-146.599	24.0	2.99	2.15	153.64
1975/04/19	15:45:16.961	61.688	-146.576	24.0	2.93	1.66	132.16
1982/10/01	07:59:15.650	61.666	-146.373	24.0	2.38	1.80	6.06
1983/05/05	06:09:04.820	61.597	-146.472	24.0	3.73	2.31	143.82
1985/03/24	14:38:57.399	61.355	-146.780	24.0	1.75	1.45	179.32
1985/06/22	12:06:14.207	61.650	-146.429	24.0	2.10	1.45	7.74
1985/11/21	19:03:26.754	61.445	-146.617	24.0	1.96	1.54	11.65
1986/01/16	14:36:36.332	61.519	-146.510	24.0	2.02	1.61	9.61
1986/10/22	18:31:34.606	61.326	-146.878	24.0	1.90	1.55	13.87
1986/10/26	05:57:50.701	61.594	-146.345	24.0	1.97	1.57	16.04
1986/11/15	07:02:13.912	61.489	-146.384	24.0	2.00	1.47	6.47
1987/06/30	08:19:32.545	61.669	-146.439	24.0	2.58	1.73	10.10
1987/08/21	20:05:29.067	61.412	-146.912	24.0	1.95	1.55	13.99
1987/12/09	11:54:45.621	61.601	-146.237	24.0	2.17	1.70	16.95
1988/03/18	02:02:09.585	61.476	-146.263	24.0	2.06	1.60	3.05
1988/12/01	10:33:59.656	61.406	-146.697	24.0	1.85	1.54	34.82
1989/06/02	06:27:36.494	61.439	-146.727	24.0	2.29	2.06	176.99
1989/10/09	03:37:55.298	61.360	-146.768	24.0	1.54	1.45	3.75
1989/10/28	07:10:56.561	61.526	-146.419	24.0	1.84	1.56	137.96
1990/02/17	00:44:06.453	61.628	-146.763	24.0	2.08	1.74	39.88
1990/04/11	10:50:24.063	61.489	-146.674	24.0	1.76	1.50	150.45
1990/11/05	16:05:09.875	61.456	-146.686	24.0	1.65	1.53	159.45
1991/01/17	05:24:30.711	61.423	-146.587	24.0	1.68	1.41	143.75

1991/01/27	01:33:37.410	61.329	-146.809	24.0	1.78	1.61	153.31
1991/03/13	05:40:30.277	61.323	-146.744	24.0	1.81	1.60	176.98
1991/03/31	11:58:18.012	61.624	-146.453	24.0	1.76	1.55	141.68
1991/04/08	09:23:53.582	61.517	-146.469	24.0	1.61	1.51	164.48
1991/05/01	01:58:13.858	61.615	-146.273	24.0	1.62	1.56	167.68
1991/10/10	20:28:46.965	61.540	-146.572	24.0	1.66	1.51	173.14
1992/01/02	16:05:52.090	61.581	-146.425	24.0	1.77	1.53	146.55
1992/01/15	15:50:50.012	61.624	-146.450	24.0	1.63	1.47	155.96
1992/02/01	20:03:30.879	61.442	-146.623	24.0	1.54	1.40	150.58
1992/02/05	15:46:30.899	61.357	-146.703	24.0	1.55	1.45	170.75
1992/02/06	09:31:11.957	61.532	-146.613	24.0	1.51	1.43	167.99
1992/02/23	18:53:12.363	61.545	-146.133	24.0	1.75	1.60	145.13
1992/03/29	17:51:24.566	61.497	-146.568	24.0	1.53	1.38	148.67
1992/04/03	00:56:03.286	61.552	-146.760	24.0	2.18	1.64	161.14
1992/04/16	23:45:50.910	61.542	-146.620	24.0	1.60	1.43	158.35
1992/05/01	01:42:24.299	61.413	-146.810	24.0	1.66	1.43	160.04
1992/07/10	08:43:17.324	61.547	-146.568	24.0	1.99	1.57	149.90
1992/07/18	05:20:31.506	61.423	-146.658	24.0	1.51	1.36	152.11
1992/08/17	06:50:22.156	61.473	-146.640	24.0	1.55	1.40	145.07
1992/09/10	04:29:40.579	61.620	-146.481	24.0	1.66	1.55	162.51
1992/09/10	08:56:31.152	61.410	-146.675	24.0	1.61	1.51	169.53
1992/11/09	04:38:47.654	61.605	-146.427	24.0	1.64	1.53	153.92
1993/01/07	23:57:55.941	61.368	-146.681	24.0	1.57	1.44	156.13
1993/02/17	02:34:49.768	61.640	-146.807	24.0	1.76	1.52	165.44
1993/02/23	18:49:43.660	61.525	-146.535	24.0	1.63	1.42	160.26
1993/03/07	08:24:56.637	61.439	-146.619	24.0	1.57	1.39	164.61
1993/03/17	16:59:47.801	61.670	-146.420	24.0	1.67	1.48	159.18
1993/05/01	06:15:58.377	61.391	-146.388	24.0	1.74	1.49	156.93
1993/05/01	21:35:33.590	61.584	-146.702	24.0	1.67	1.41	151.00
1993/08/25	02:46:27.665	61.442	-146.537	24.0	1.48	1.42	160.77
1993/09/22	16:03:52.063	61.339	-146.222	24.0	1.67	1.51	172.39
1993/10/07	19:29:09.981	61.429	-146.495	24.0	1.78	1.49	156.91
1993/10/19	11:37:46.113	61.586	-146.209	24.0	1.44	1.41	170.83
1993/10/23	16:08:13.387	61.492	-146.761	24.0	1.58	1.49	161.66
1993/10/30	20:44:49.285	61.658	-146.561	24.0	1.59	1.47	154.26
1994/03/21	12:41:18.559	61.504	-146.396	24.0	1.81	1.62	158.30
1994/06/18	07:22:43.871	61.619	-146.689	24.0	1.58	1.36	140.91
1994/07/10	16:25:43.195	61.533	-146.406	24.0	1.79	1.52	147.36
1994/08/25	05:40:11.567	61.736	-146.461	24.0	1.92	1.76	157.80
1995/02/10	14:25:00.942	61.737	-146.694	24.0	1.71	1.53	146.43
1995/07/19	08:23:01.049	61.582	-146.449	24.0	1.69	1.53	170.20
1995/07/19	09:32:08.883	61.586	-146.454	24.0	1.57	1.52	146.97

1995/07/27	22:11:36.254	61.451	-146.643	24.0	1.69	1.58	165.88
1995/08/21	19:14:38.051	61.519	-146.513	24.0	1.73	1.57	4.12
1995/08/25	02:14:25.360	61.313	-146.739	24.0	1.48	1.38	0.01
1995/10/01	01:47:46.439	61.359	-146.584	24.0	1.51	1.42	165.42
1995/10/28	10:22:56.707	61.514	-146.593	24.0	1.52	1.42	152.72
1996/01/12	07:25:46.557	61.337	-146.764	24.0	2.24	1.75	157.99
1996/02/11	12:48:41.801	61.649	-146.643	24.0	1.82	1.50	140.36
1996/04/29	05:32:17.188	61.345	-146.789	24.0	1.58	1.42	157.53
1996/05/20	01:04:13.461	61.614	-146.334	24.0	1.76	1.59	138.19
1996/06/02	03:17:18.026	61.417	-146.825	24.0	1.93	1.65	155.41
1996/08/27	21:25:58.918	61.519	-146.317	24.0	1.46	1.40	155.16
1996/09/30	01:16:44.437	61.470	-146.644	24.0	1.73	1.51	158.78
1996/12/24	08:49:13.668	61.502	-146.431	24.0	1.47	1.35	146.90
1997/02/13	07:19:53.670	61.520	-146.683	24.0	1.46	1.35	150.81
1997/05/08	12:31:18.555	61.450	-146.608	24.0	1.52	1.39	122.41
1997/05/18	19:10:33.395	61.511	-146.621	24.0	1.60	1.49	125.00
1997/10/22	15:22:41.277	61.515	-146.674	24.0	1.63	1.53	145.90
1998/01/19	17:19:47.645	61.363	-146.795	24.0	1.74	1.56	150.40
1998/02/22	22:18:05.762	61.336	-146.796	24.0	2.05	1.77	152.06
1998/03/15	02:02:21.222	61.416	-146.612	24.0	1.51	1.40	136.88
1998/04/10	12:50:50.070	61.513	-146.553	24.0	1.48	1.38	132.60
1998/05/02	02:24:46.483	61.635	-146.292	24.0	1.61	1.49	106.05
1998/06/13	18:28:40.723	61.604	-146.349	24.0	1.66	1.48	98.40
1998/07/23	15:23:06.684	61.376	-146.672	24.0	1.78	1.59	153.39
1999/01/25	02:29:09.606	61.508	-146.597	24.0	1.69	1.52	155.59
1999/02/25	05:51:00.428	61.371	-146.537	24.0	1.57	1.44	114.98
1999/03/01	21:09:50.434	61.544	-146.555	24.0	1.73	1.62	105.74
1999/03/03	04:53:57.104	61.512	-146.570	24.0	1.81	1.54	106.03
1999/04/03	09:22:46.942	61.601	-146.292	24.0	1.69	1.45	106.41
1999/04/04	00:44:53.373	61.600	-146.284	24.0	1.57	1.51	21.38
1999/05/12	09:05:34.834	61.765	-146.533	24.0	1.67	1.50	102.79
1999/12/10	09:03:52.758	61.429	-146.526	24.0	2.13	1.83	127.93
2000/02/15	05:12:44.125	61.498	-146.409	24.0	1.43	1.34	143.52
2000/02/23	04:44:59.891	61.537	-146.388	24.0	1.45	1.42	120.26
2000/02/26	21:07:59.066	61.380	-146.763	24.0	1.56	1.46	133.45
2000/03/08	11:10:38.770	61.500	-146.602	24.0	1.56	1.40	121.26
2000/05/02	10:34:47.941	61.414	-146.711	24.0	1.84	1.70	144.82
2000/05/02	10:57:22.109	61.410	-146.706	24.0	1.75	1.70	116.73
2000/06/18	02:07:49.851	61.543	-146.373	24.0	1.83	1.56	97.40
2000/09/25	07:55:22.660	61.670	-146.390	24.0	1.56	1.46	167.56
2000/09/28	06:53:49.193	61.392	-146.867	24.0	1.94	1.61	165.30
2000/10/15	22:19:22.856	61.429	-146.710	24.0	1.72	1.68	17.27

2000/11/10	04:59:43.535	61.737	-146.541	24.0	1.48	1.45	77.38
2000/11/12	20:21:23.160	61.629	-146.453	24.0	1.47	1.41	82.95
2001/05/26	09:24:40.606	61.431	-146.780	24.0	3.08	1.94	9.40
2001/05/29	02:52:49.353	61.547	-146.502	24.0	1.42	1.40	134.10
2001/06/18	14:48:56.820	61.450	-146.588	24.0	1.92	1.58	174.47
2001/08/17	21:45:55.324	61.466	-146.568	24.0	1.66	1.60	62.05
2001/11/23	23:38:08.465	61.603	-146.671	24.0	1.47	1.44	156.32
2002/01/25	22:27:35.012	61.441	-146.613	24.0	1.46	1.34	156.07
2002/03/01	05:52:06.504	61.654	-146.474	24.0	1.46	1.41	109.18
2002/04/17	08:38:55.274	61.418	-146.621	24.0	1.64	1.50	159.85
2002/07/12	09:43:18.961	61.385	-146.608	24.0	1.45	1.38	133.94
2002/07/26	20:06:45.488	61.518	-146.697	24.0	1.36	1.31	122.76
2002/09/17	06:24:02.539	61.583	-146.455	24.0	1.40	1.37	100.31
2002/09/29	17:04:59.668	61.294	-146.587	24.0	1.56	1.52	176.64
2002/10/07	11:33:18.922	61.634	-146.319	24.0	1.39	1.36	123.67
2002/10/18	10:15:23.645	61.589	-146.445	24.0	1.59	1.56	106.75
2002/10/24	16:55:51.668	61.538	-146.586	24.0	1.84	1.51	169.93
2003/02/12	12:58:32.988	61.457	-146.612	24.0	2.82	2.37	91.88
2003/05/20	13:26:43.652	61.415	-146.606	24.0	3.74	2.48	138.73
2003/08/29	22:07:45.629	61.740	-146.544	24.0	1.48	1.41	122.90
2003/09/30	06:34:47.020	61.550	-146.572	24.0	1.70	1.49	169.02
2003/11/05	11:13:19.262	61.507	-146.354	24.0	1.55	1.42	176.89
2004/02/03	03:20:03.699	61.700	-146.522	24.0	1.48	1.42	2.50
2004/03/27	13:45:24.188	61.600	-146.260	24.0	1.52	1.49	82.55
2004/06/25	07:13:55.207	61.509	-146.540	24.0	1.48	1.38	111.32
2004/06/25	07:16:58.244	61.513	-146.527	24.0	1.42	1.39	127.18
2004/08/01	07:17:01.625	61.471	-146.460	24.0	1.43	1.36	163.62
2004/08/01	14:44:38.383	61.507	-146.675	24.0	1.45	1.42	28.61
2004/08/18	03:35:40.320	61.307	-146.417	24.0	1.49	1.46	149.99
2004/08/18	06:54:59.170	61.538	-146.251	24.0	1.43	1.40	159.97
Kumamoto, Kyushu							
1965/12/08	05:25:11.909	32.531	130.575	11.3	2.54	2.28	66.59
1976/09/27	17:32:41.899	32.634	130.834	11.3	2.51	2.27	57.48
1977/06/28	02:46:43.176	32.888	130.712	11.3	2.75	2.29	43.16
1990/06/27	15:16:42.614	32.775	130.501	11.3	2.78	2.32	73.41
1990/11/16	11:33:04.895	32.515	130.561	11.3	2.58	2.23	78.41
1992/07/01	17:55:53.981	32.755	130.733	11.3	2.14	2.05	108.21
1996/06/29	09:13:22.141	32.800	130.644	11.3	2.17	1.95	103.17
1996/10/17	01:23:17.386	32.667	130.868	11.3	2.23	2.02	103.12
1997/04/23	01:24:28.584	32.736	130.646	11.3	2.21	2.02	106.78
1998/07/16	20:08:45.075	32.711	130.852	11.3	2.23	2.04	100.48
1999/11/09	18:19:17.551	32.722	130.798	11.3	2.11	1.93	102.79

2000/06/08	00:32:46.546	32.692	130.761	11.3	2.15	1.96	102.62
2000/06/09	20:39:22.176	32.707	130.772	11.3	2.18	1.99	102.28
2000/08/10	02:37:09.863	32.757	130.807	11.3	2.16	1.97	102.37
2001/03/04	10:20:03.457	32.685	130.743	11.3	2.56	2.03	91.66
2001/03/25	10:43:25.368	32.745	130.512	11.3	2.70	2.19	120.47
2002/05/20	13:19:42.957	32.643	130.788	11.3	2.87	2.15	91.70
Owase, Honshu							
1965/01/21	02:41:05.682	33.661	136.280	34.4	3.61	2.47	167.06
1967/08/30	20:32:32.693	34.025	136.558	34.4	3.15	2.35	172.69
1975/08/11	09:57:16.513	33.971	135.950	34.4	4.27	2.68	162.10
1982/08/18	11:08:18.493	33.843	135.891	34.4	3.50	2.33	170.11
1987/04/11	18:47:33.630	33.813	136.370	34.4	3.14	2.31	179.84
1989/08/27	18:34:29.099	33.860	135.747	34.4	2.82	2.15	177.99
1992/09/02	20:12:12.247	33.970	136.552	34.4	3.11	2.22	177.63
1996/01/04	03:52:02.510	34.135	136.041	34.4	2.79	2.27	171.75
1996/06/02	03:41:03.141	34.008	136.147	34.4	2.93	2.27	179.63
1996/08/04	23:18:09.951	34.187	136.552	34.4	2.88	2.20	178.02
1997/05/30	13:10:38.775	33.918	135.801	34.4	3.04	2.37	178.13
1997/09/10	15:10:28.771	34.027	136.521	34.4	3.00	2.35	179.67
2000/10/30	16:42:53.075	34.279	136.313	34.4	3.44	2.73	34.74
2001/09/12	20:42:56.536	33.840	136.181	34.4	4.07	3.10	179.86
Kyoto, Honshu							
1966/03/10	03:48:41.838	35.174	135.751	2.5	2.14	1.91	165.74
1972/08/31	07:54:21.367	35.257	135.680	2.5	2.08	1.86	164.98
1984/06/24	17:03:15.779	35.119	135.791	2.5	1.82	1.74	76.16
1987/05/27	21:03:34.627	35.023	135.534	2.5	1.73	1.62	60.53
1994/06/28	04:08:41.934	35.141	135.656	2.5	1.73	1.63	60.48
1994/10/24	02:51:05.946	35.012	135.512	2.5	1.75	1.63	53.00
1995/02/19	05:01:21.937	35.083	135.677	2.5	1.75	1.64	57.46
1995/03/23	10:26:10.588	35.076	135.786	2.5	1.73	1.60	59.08
1995/07/23	19:00:02.166	34.942	135.557	2.5	1.78	1.72	42.19
1996/05/29	08:37:46.479	35.016	135.653	2.5	1.72	1.62	58.09
1996/07/18	04:44:16.145	35.027	135.781	2.5	1.73	1.65	58.76
1997/01/08	13:36:29.947	35.154	135.531	2.5	1.75	1.66	54.48
1997/09/06	17:19:36.103	35.053	135.542	2.5	1.78	1.71	53.79
1999/02/11	18:16:46.322	34.992	135.566	2.5	2.09	1.71	43.79
1999/11/10	13:24:49.791	35.260	135.856	2.5	2.15	1.80	40.27
2000/05/15	19:09:26.447	34.970	135.504	2.5	2.10	1.69	34.52
2000/05/21	01:42:35.477	35.042	135.804	2.5	1.85	1.66	51.39
2001/08/25	13:21:26.428	35.148	135.692	2.5	1.99	1.78	30.72
2002/07/16	11:08:58.596	35.066	135.665	2.5	2.46	1.75	26.30
Miyakejima, Bonin islands							

2000/06/28	15:14:06.652	34.203	139.335	10.0	2.46	1.55	66.26
2000/06/29	02:55:15.244	34.256	139.218	10.0	1.68	1.47	31.58
2000/06/29	02:56:22.612	34.227	139.202	10.0	1.86	1.75	49.94
2000/06/29	03:11:53.171	34.241	139.226	10.0	1.69	1.42	40.99
2000/06/29	03:34:27.971	34.253	139.266	10.0	1.67	1.43	35.78
2000/06/29	03:41:57.381	34.193	139.261	10.0	2.09	1.53	58.20
2000/06/30	17:41:18.957	34.224	139.295	10.0	1.70	1.41	41.39
2000/06/30	18:57:19.023	34.182	139.284	10.0	1.68	1.42	44.85
2000/06/30	19:11:46.133	34.202	139.285	10.0	1.74	1.45	46.71
2000/07/01	00:10:49.662	34.162	139.294	10.0	1.82	1.47	56.75
2000/07/01	03:49:08.510	34.181	139.276	10.0	1.71	1.42	47.81
2000/07/01	04:52:27.115	34.201	139.243	10.0	2.16	1.52	65.15
2000/07/01	07:11:44.150	34.212	139.329	10.0	1.75	1.55	39.17
2000/07/01	15:00:22.906	34.150	139.299	10.0	1.78	1.43	48.09
2000/07/01	17:48:44.773	34.157	139.341	10.0	1.98	1.45	57.74
2000/07/01	19:01:37.555	34.200	139.215	10.0	1.95	1.51	46.83
2000/07/01	21:53:29.531	34.159	139.263	10.0	1.71	1.46	40.18
2000/07/01	23:28:27.680	34.143	139.307	10.0	1.80	1.43	46.14
2000/07/02	20:08:06.539	34.130	139.352	10.0	3.53	1.55	68.09
2000/07/02	20:09:13.461	34.127	139.337	10.0	1.72	1.40	40.19
2000/07/02	20:27:10.297	34.140	139.329	10.0	2.81	1.48	68.27
2000/07/02	21:59:12.953	34.180	139.280	10.0	2.74	1.53	69.41
2000/07/03	01:57:57.260	34.147	139.340	10.0	2.84	1.80	69.95
2000/07/04	21:51:04.359	34.160	139.352	10.0	1.72	1.42	41.23
2000/07/04	22:14:58.336	34.172	139.370	10.0	2.04	1.48	58.81
2000/07/05	02:19:14.536	34.159	139.345	10.0	1.91	1.45	51.60
2000/07/05	02:55:22.596	34.142	139.332	10.0	4.46	1.70	71.18
2000/07/05	03:56:11.891	34.148	139.360	10.0	2.06	1.50	59.85
2000/07/05	12:42:32.637	34.148	139.327	10.0	3.13	1.50	70.61
2000/07/06	10:13:01.645	34.181	139.255	10.0	1.81	1.50	45.00
2000/07/06	10:47:55.969	34.174	139.262	10.0	1.93	1.46	55.73
2000/07/06	11:51:17.285	34.172	139.259	10.0	1.70	1.53	41.60
2000/07/06	12:26:38.270	34.187	139.275	10.0	1.73	1.53	45.77
2000/07/06	14:16:47.715	34.187	139.267	10.0	2.30	1.51	64.40
2000/07/06	14:48:10.711	34.187	139.262	10.0	1.81	1.49	49.52
2000/07/06	17:01:08.359	34.195	139.239	10.0	2.92	1.68	69.39
2000/07/06	19:19:15.305	34.182	139.291	10.0	1.80	1.42	38.92
2000/07/07	02:45:28.101	34.193	139.247	10.0	1.72	1.40	38.10
2000/07/08	17:20:01.730	34.216	139.265	10.0	2.36	2.05	73.05
2000/07/08	17:37:24.531	34.209	139.252	10.0	2.35	2.11	62.59
2000/07/08	19:09:52.602	34.188	139.370	10.0	1.81	1.45	43.11
2000/07/08	19:53:24.406	34.196	139.276	10.0	2.62	1.57	66.13

2000/07/09	19:15:24.672	34.189	139.274	10.0	2.57	2.00	82.60
2000/07/10	11:15:48.988	34.173	139.259	10.0	1.72	1.44	38.88
2000/07/10	16:25:32.152	34.153	139.274	10.0	1.72	1.41	44.30
2000/07/10	16:38:24.395	34.168	139.298	10.0	2.23	1.48	65.96
2000/07/10	16:49:39.129	34.145	139.322	10.0	3.00	1.52	68.10
2000/07/11	04:56:58.934	34.181	139.317	10.0	1.86	1.54	52.31
2000/07/11	09:44:28.336	34.198	139.240	10.0	2.21	1.67	75.90
2000/07/11	10:06:52.598	34.290	139.264	10.0	2.37	1.82	54.38
2000/07/11	18:23:51.937	34.248	139.228	10.0	2.39	2.15	71.80
2000/07/11	18:57:33.695	34.197	139.259	10.0	2.40	1.81	65.33
2000/07/12	03:12:29.310	34.181	139.330	10.0	2.30	1.67	66.90
2000/07/12	03:19:03.506	34.200	139.263	10.0	2.27	1.78	68.46
2000/07/12	03:36:45.526	34.201	139.275	10.0	2.06	1.72	62.66
2000/07/12	05:08:13.334	34.159	139.294	10.0	2.78	1.78	69.59
2000/07/12	05:43:10.404	34.153	139.326	10.0	2.67	1.78	69.15
2000/07/12	07:03:43.828	34.169	139.348	10.0	2.48	1.81	61.85
2000/07/12	07:43:41.434	34.158	139.315	10.0	2.48	1.67	68.04
2000/07/12	08:43:09.830	34.188	139.301	10.0	2.51	1.81	78.25
2000/07/12	09:58:46.973	34.181	139.303	10.0	2.38	1.91	88.70
2000/07/12	11:39:05.613	34.155	139.307	10.0	2.91	1.94	75.77
2000/07/12	12:34:36.102	34.192	139.281	10.0	2.73	2.10	75.40
2000/07/12	13:08:59.031	34.148	139.342	10.0	3.08	1.95	75.79
2000/07/12	14:07:15.785	34.160	139.313	10.0	2.18	1.72	66.28
2000/07/12	21:20:27.508	34.158	139.317	10.0	2.76	1.67	72.61
2000/07/13	07:17:40.621	34.188	139.235	10.0	2.52	1.90	67.77
2000/07/13	22:27:53.109	34.414	139.217	10.0	2.12	1.98	51.92
2000/07/14	00:49:32.300	34.153	139.285	10.0	1.70	1.43	44.29
2000/07/14	10:19:30.332	34.211	139.220	10.0	2.00	1.49	60.66
2000/07/14	10:24:25.852	34.219	139.275	10.0	1.83	1.67	119.57
2000/07/14	20:28:07.383	34.161	139.277	10.0	1.75	1.42	43.55
2000/07/14	21:36:32.469	34.140	139.301	10.0	2.44	1.74	69.17
2000/07/15	01:11:40.545	34.399	139.275	10.0	2.20	1.88	46.44
2000/07/15	01:30:32.407	34.447	139.273	10.0	1.73	1.43	40.24
2000/07/15	02:16:20.535	34.158	139.316	10.0	2.01	1.51	62.53
2000/07/15	06:49:58.199	34.222	139.255	10.0	2.07	1.53	57.94
2000/07/19	11:06:18.043	34.237	139.269	10.0	1.73	1.40	37.01
2000/07/19	12:20:26.027	34.155	139.340	10.0	1.82	1.45	52.71
2000/07/20	01:48:50.646	34.174	139.278	10.0	1.73	1.41	40.05
2000/07/21	07:55:58.418	34.208	139.254	10.0	1.82	1.52	40.74
2000/07/22	15:24:36.848	34.196	139.256	10.0	1.74	1.50	43.95
2000/07/24	00:03:21.014	34.140	139.326	10.0	2.30	1.49	67.38
2000/07/24	10:43:02.461	34.152	139.293	10.0	2.96	1.55	68.05

2000/07/27	02:12:51.844	34.219	139.297	10.0	1.71	1.40	36.20
2000/07/27	02:15:17.871	34.153	139.267	10.0	1.68	1.63	51.11
2000/07/28	20:16:47.516	34.140	139.279	10.0	1.64	1.55	42.29
2000/07/29	15:16:19.746	34.205	139.249	10.0	1.63	1.40	33.91
2000/07/30	08:42:27.523	34.189	139.233	10.0	1.78	1.69	88.78
2000/07/30	23:53:23.281	34.265	139.133	10.0	1.81	1.45	43.39
2000/07/31	20:00:03.914	34.263	139.286	10.0	3.03	1.57	69.12
2000/08/02	10:43:56.500	34.178	139.369	10.0	1.73	1.44	42.48
2000/08/03	07:20:39.645	34.177	139.288	10.0	1.74	1.47	47.70
2000/08/03	07:24:03.662	34.161	139.292	10.0	2.09	1.63	62.69
2000/08/03	07:53:50.816	34.184	139.296	10.0	1.76	1.44	41.49
2000/08/03	08:31:51.021	34.173	139.306	10.0	2.72	2.15	88.14
2000/08/03	09:04:46.805	34.232	139.286	10.0	1.73	1.40	38.79
2000/08/03	11:16:37.145	34.198	139.281	10.0	1.69	1.48	35.05
2000/08/03	11:19:06.762	34.183	139.255	10.0	1.98	1.67	53.43
2000/08/03	11:46:06.465	34.215	139.243	10.0	2.11	1.73	133.82
2000/08/03	12:17:22.066	34.326	139.293	10.0	2.02	1.50	49.25
2000/08/03	15:42:02.816	34.216	139.256	10.0	1.71	1.62	41.52
2000/08/04	21:21:06.703	34.181	139.280	10.0	2.47	1.50	66.50
2000/08/05	04:15:37.351	34.210	139.300	10.0	1.68	1.40	41.08
2000/08/07	09:04:11.797	34.197	139.465	10.0	1.95	1.44	54.84
2000/08/07	14:25:37.070	34.203	139.262	10.0	1.88	1.46	54.79
2000/08/07	17:30:49.457	34.212	139.249	10.0	2.33	1.49	67.15
2000/08/09	03:06:37.633	34.240	139.285	10.0	3.09	1.69	63.29
2000/08/12	17:19:55.980	34.213	139.242	10.0	2.05	1.57	63.11
2000/08/15	18:19:02.172	34.131	139.316	10.0	1.79	1.56	53.59
2000/08/15	20:25:43.930	34.142	139.348	10.0	2.45	1.55	68.66
2000/08/15	20:27:47.984	34.133	139.333	10.0	2.36	1.50	66.88
2000/08/20	07:24:09.885	34.098	139.359	10.0	2.30	1.49	64.37
2000/08/22	21:21:22.938	34.190	139.268	10.0	2.35	1.49	65.86
2000/08/29	02:00:37.587	34.424	139.199	10.0	1.72	1.44	43.04
2000/10/30	19:20:37.461	34.366	139.219	10.0	1.78	1.44	47.32
Tottori, Honshu							
1991/08/28	01:29:01.246	35.267	133.264	7.5	3.50	2.83	146.67
1997/08/22	23:35:29.867	35.294	133.430	7.5	3.26	2.41	131.16
1997/09/03	20:15:43.391	35.289	133.417	7.5	3.02	2.41	124.08
2000/07/16	23:00:04.727	35.411	133.436	7.5	2.95	2.31	125.46
2000/10/06	05:36:11.496	35.226	133.441	7.5	3.52	2.76	131.34
2000/10/06	14:13:21.590	35.336	133.281	1.3	3.07	2.50	122.31
2000/10/06	19:59:30.750	35.322	133.395	7.5	3.00	2.40	120.19
2000/10/07	21:08:21.320	35.360	133.317	7.5	3.03	2.53	121.71
2001/02/11	00:17:28.558	35.437	133.304	7.5	2.98	2.44	123.22

2001/04/14	01:44:14.170	35.201	133.463	7.5	3.14	2.61	116.51
2002/01/24	07:08:34.430	35.389	133.362	7.5	2.99	2.32	123.74
2002/03/05	22:12:27.836	35.343	133.358	7.5	2.98	2.41	122.77
Acapulco, Mexico							
1992/11/10	02:13:25.761	16.947	-100.067	17.9	4.60	2.73	15.45
1996/09/03	11:45:02.655	16.653	-100.006	17.9	4.62	2.59	16.15
1998/07/05	19:55:07.721	16.895	-100.021	15.4	4.59	2.85	18.18
1998/07/12	08:11:27.647	16.890	-100.378	15.4	4.35	2.47	23.05
1998/07/17	11:18:01.034	16.990	-100.063	15.4	4.42	2.96	16.42
2001/03/05	10:17:34.229	17.157	-100.063	20.4	4.29	2.62	19.23
2001/03/06	21:57:54.502	17.141	-100.062	20.4	4.26	2.51	17.26
2001/10/08	03:39:18.980	17.001	-100.048	5.4	4.26	2.44	21.59
2001/10/08	03:59:55.427	17.013	-100.105	5.4	4.53	3.51	23.04
2001/10/09	00:34:21.544	17.021	-100.094	5.4	4.79	3.54	18.35
2001/10/29	05:23:12.012	17.078	-100.102	5.4	4.15	2.39	20.02
2002/01/20	08:34:36.848	17.036	-99.995	10.4	4.76	3.08	21.31
2002/02/14	15:30:22.596	17.026	-100.034	5.4	4.94	3.25	21.00
2002/02/17	04:10:18.607	17.067	-99.903	17.9	4.44	3.06	7.91
2002/03/07	22:08:10.885	17.023	-100.108	5.4	4.82	4.38	23.16
2002/06/22	10:15:32.647	17.206	-99.697	20.4	4.60	2.59	15.63
2002/09/25	18:14:48.510	16.862	-100.014	17.9	4.18	2.32	19.42
2002/09/27	07:04:56.651	17.210	-100.478	25.4	4.32	2.44	20.91
2003/01/10	02:08:01.052	16.969	-100.283	20.4	4.38	2.50	19.39
San Vicente, El Salvador							
2001/02/13	16:15:59.891	13.712	-88.723	10.0	4.97	2.09	19.08
2001/02/13	19:22:10.281	13.648	-88.725	10.0	4.78	2.08	17.97
2001/05/09	07:23:14.779	13.616	-88.674	10.0	4.60	2.00	18.31
Cerro Negro, Nicaragua							
1999/08/05	04:24:46.113	12.498	-86.706	1.7	4.52	2.11	31.32
1999/08/05	04:35:55.216	12.494	-86.723	5.7	4.19	2.06	31.58
1999/08/05	04:48:31.796	12.501	-86.693	3.7	4.43	2.13	32.46
1999/08/05	04:50:58.095	12.475	-86.717	6.7	4.25	2.07	31.58
1999/08/05	05:08:55.209	12.512	-86.695	4.7	4.78	2.21	31.04
1999/08/05	05:11:08.791	12.485	-86.706	3.7	4.63	2.15	30.94
1999/08/05	05:39:49.216	12.506	-86.705	7.7	4.24	2.07	31.57
1999/08/05	06:29:32.976	12.475	-86.722	7.7	4.37	2.15	33.03
1999/08/05	08:01:54.742	12.500	-86.720	10.7	4.43	2.13	31.91
1999/08/05	09:20:33.687	12.484	-86.719	13.7	4.50	2.16	33.94
1999/08/05	09:47:30.281	12.448	-86.734	16.7	4.89	2.16	34.22
San Marcos, Costa Rica							
1984/10/25	09:24:06.690	9.439	-83.667	22.0	4.60	4.11	4.84
1987/07/15	23:30:57.674	9.673	-83.729	22.0	4.86	3.76	126.10

1987/11/19	16:02:18.666	9.688	-83.617	17.0	3.74	3.05	35.72
1989/02/26	12:21:10.909	9.722	-84.125	19.5	4.22	2.96	35.76
1990/06/08	00:31:50.641	9.862	-84.279	12.0	4.42	2.96	53.44
1990/12/22	17:27:55.092	9.892	-84.300	22.0	3.66	2.76	50.18
1993/07/08	23:18:57.651	9.783	-83.650	17.0	3.70	3.16	16.35
1993/07/10	20:40:58.330	9.781	-83.647	22.0	3.30	2.84	24.91
1993/07/13	15:10:10.580	9.769	-83.578	12.0	3.79	3.08	4.03
Amatitlan, Guatemala							
1978/03/30	19:30:08.134	15.075	-90.412	10.3	4.95	3.83	142.95
1993/04/19	00:17:57.785	14.225	-90.266	10.3	4.78	4.38	19.87
1993/04/19	01:52:04.712	14.260	-90.261	10.3	4.81	4.29	8.34
Ambato, Ecuador							
1994/07/07	22:54:10.539	-1.121	-78.306	5.0	3.92	2.48	72.42
1996/03/28	23:03:47.164	-1.046	-78.771	9.0	3.76	2.32	84.77
1996/08/25	14:08:58.191	-1.128	-78.730	7.5	4.02	2.50	86.38
2002/05/05	11:35:06.484	-1.130	-78.503	5.0	4.61	2.48	79.54
2004/03/28	08:41:12.352	-1.187	-78.484	7.5	4.96	3.34	58.11
Redonda, Leeward islands							
1985/03/17	03:41:12.451	16.987	-62.317	15.0	3.80	2.39	37.64
1985/03/19	16:53:44.070	16.957	-62.359	15.0	3.91	2.56	37.82
1985/04/04	06:01:01.666	16.976	-62.377	15.0	4.00	2.64	34.83
1985/04/06	03:53:48.854	17.037	-62.337	15.0	4.12	3.87	131.29
1985/04/09	12:30:44.750	16.995	-62.379	15.0	4.00	2.95	34.91
1985/04/10	07:02:06.184	16.980	-62.385	15.0	3.92	2.59	37.74
1985/04/13	04:12:40.536	16.994	-62.375	15.0	3.73	2.42	36.63
1985/06/24	21:19:41.031	17.083	-62.394	15.0	3.89	2.63	37.92
1986/02/12	23:41:38.781	17.005	-62.299	15.0	3.68	2.36	36.60
1986/02/12	23:53:43.312	17.006	-62.290	15.0	3.85	2.75	37.79
1986/03/01	08:38:53.281	17.018	-62.309	15.0	3.74	2.47	36.47
1986/10/05	09:12:10.531	17.005	-62.308	15.0	3.67	2.39	36.38
1989/04/14	13:30:45.043	17.001	-62.309	15.0	4.01	2.85	40.92
Tobago							
1997/04/05	07:06:31.758	11.108	-60.686	5.4	4.77	2.93	122.53
1997/04/08	09:37:47.286	11.067	-60.703	5.4	4.85	2.71	126.90
1997/04/08	17:11:55.208	11.091	-60.700	5.4	3.08	2.26	119.60
1997/04/08	23:46:13.602	11.091	-60.713	5.4	4.65	2.61	121.94
1997/04/09	00:50:12.665	11.099	-60.738	5.4	3.52	2.36	122.11
1997/04/11	06:57:48.175	11.079	-60.771	5.4	3.59	2.36	121.23
1997/04/12	03:05:32.273	11.058	-60.752	5.4	4.38	2.55	125.69
1997/04/16	11:42:58.071	11.081	-60.730	5.4	4.96	2.77	126.36
1997/04/22	10:11:47.219	11.114	-60.660	5.4	3.12	2.28	121.99
1997/04/22	10:18:55.848	11.090	-60.895	5.4	3.64	3.28	150.31

1997/04/22	10:30:16.106	11.070	-60.881	5.4	3.72	2.46	121.86
1997/04/22	11:00:25.567	11.090	-60.771	5.4	4.39	2.59	116.15
1997/04/22	11:44:14.634	11.036	-60.879	5.4	4.68	2.75	123.12
1997/04/22	19:05:52.532	11.147	-60.698	5.4	4.97	2.82	125.85
1997/04/23	22:25:03.469	11.170	-60.618	5.4	3.29	2.29	123.24
1997/05/03	22:39:17.876	11.104	-60.908	5.4	3.25	2.32	118.99
1997/05/04	01:44:51.984	11.086	-60.893	5.4	2.99	2.22	117.45
1997/05/09	18:21:40.743	11.033	-60.990	5.4	3.58	2.42	121.95
1997/05/16	21:17:56.477	11.077	-60.937	5.4	3.16	2.28	117.84
1998/07/23	06:36:38.798	11.183	-60.702	5.4	4.76	2.67	121.94
Puente Alto, Chile							
1975/09/14	12:03:11.086	-33.882	-70.626	15.4	4.37	4.11	107.13
1981/12/14	03:54:17.438	-33.623	-70.396	15.4	4.64	3.67	116.63
1984/03/20	06:50:20.394	-33.286	-70.112	15.4	4.31	3.35	117.60
1985/11/14	23:33:23.597	-33.201	-70.036	15.4	4.72	3.63	114.27
1985/11/15	01:54:44.292	-33.217	-70.035	15.4	4.60	3.46	110.40
1989/01/28	09:44:54.304	-33.285	-70.221	15.4	4.46	3.58	109.50
1993/04/12	17:42:37.554	-33.280	-70.081	15.4	4.32	3.37	104.12
1993/04/23	06:05:39.900	-33.505	-70.496	15.4	4.76	4.20	95.94
1993/08/20	04:00:09.408	-33.651	-70.491	15.4	4.27	3.12	96.84
1995/06/12	17:47:18.000	-33.713	-70.438	15.4	4.25	3.07	95.47
2001/06/26	03:44:48.146	-33.785	-70.307	15.4	4.44	3.21	96.75
San Juan, Argentina							
1980/04/18	08:48:55.525	-31.411	-68.837	11.7	4.86	3.80	7.15
1982/11/11	19:37:40.672	-31.363	-68.879	11.7	4.67	3.50	9.81
1995/05/18	21:53:56.758	-31.617	-68.681	16.7	3.80	2.99	153.27
Lake Tekapo, New Zealand							
1977/10/25	16:49:46.321	-43.278	170.827	6.8	4.98	3.40	133.04
1984/06/24	13:29:39.383	-43.575	170.676	4.3	3.60	3.26	140.92
1984/06/24	13:43:27.598	-43.645	170.704	6.8	4.41	3.45	144.85
1984/08/21	15:17:00.919	-43.622	170.690	4.3	4.34	3.33	129.84
1985/01/30	11:32:06.047	-43.635	170.685	4.3	4.40	3.42	132.53
1988/08/20	07:56:14.903	-43.520	170.608	6.8	4.89	3.40	133.53
1991/08/02	12:51:35.165	-43.533	171.155	6.8	3.83	3.25	134.55
1992/01/08	20:41:59.770	-43.502	171.137	9.3	3.76	3.29	140.27
1993/12/28	02:54:18.581	-43.373	170.896	9.3	4.26	3.28	134.33
1994/04/14	03:06:35.155	-43.439	171.033	9.3	4.25	3.32	135.93
1994/11/29	13:36:25.583	-43.931	170.693	6.8	4.67	3.29	127.43
2001/05/18	10:56:54.883	-43.439	171.036	4.3	3.58	3.26	142.02
2002/05/29	11:57:25.848	-43.428	170.917	14.3	4.98	3.49	142.50
2004/08/19	16:03:39.219	-43.842	170.851	6.8	4.06	3.53	126.10
Inangahua, New Zealand							

1968/05/24	10:24:09.019	-41.657	172.056	7.7	4.59	2.68	125.75
1968/05/24	17:40:51.757	-41.817	171.910	2.7	4.27	2.97	127.23
1968/05/24	21:37:34.773	-41.790	171.862	10.2	4.93	2.84	124.93
1968/05/25	02:10:57.132	-41.961	171.848	2.7	4.37	3.32	127.67
1968/05/25	11:18:12.035	-41.863	171.918	2.7	4.21	2.99	131.73
1968/05/25	23:49:14.554	-41.896	171.872	2.7	4.13	2.83	123.46
1968/05/26	20:37:36.453	-41.754	171.991	2.7	4.49	2.92	142.34
1968/05/30	04:24:56.142	-41.852	171.986	2.7	4.18	2.78	125.17
1968/06/05	12:43:16.609	-41.801	171.949	7.7	4.15	3.03	133.22
1968/06/09	19:06:32.703	-41.898	172.064	7.7	4.67	3.62	152.54
1968/06/14	19:03:26.046	-41.841	172.006	5.2	4.05	2.82	132.07
1968/06/20	03:08:04.144	-42.000	171.789	7.7	4.42	3.83	103.67
1968/06/23	11:14:42.816	-41.930	171.921	2.7	4.37	3.12	131.15
1971/08/13	14:42:40.488	-42.098	172.212	2.7	4.42	2.49	131.03
1991/01/28	18:00:53.972	-41.948	171.792	10.2	4.08	2.58	133.03
1991/01/28	21:37:36.749	-41.961	171.824	12.7	4.35	2.65	132.49
1991/01/29	14:10:24.406	-41.896	171.712	7.7	4.03	2.53	129.17
1991/02/15	10:48:10.863	-42.043	171.651	10.2	3.87	2.43	129.81
1991/02/15	13:36:27.156	-42.082	171.658	10.2	3.94	2.42	129.32
1991/02/24	00:50:33.846	-42.057	171.612	2.7	4.37	2.67	134.61
1991/02/28	10:26:16.375	-42.075	171.652	10.2	4.07	2.52	131.01
1991/05/01	11:39:01.554	-41.970	171.762	10.2	4.29	2.61	133.21
1992/12/04	13:01:32.675	-42.045	171.895	10.2	4.77	3.03	130.20
1992/12/04	21:45:47.750	-41.984	171.861	12.7	4.19	2.58	130.90
1992/12/05	23:18:51.148	-41.990	171.838	10.2	4.41	2.76	131.45
1994/07/16	09:17:59.171	-42.073	171.711	12.7	4.12	2.56	130.56
2004/05/15	23:56:16.250	-41.762	171.966	12.7	4.36	2.75	125.13
Arthur's Pass, New Zealand							
1965/05/31	23:37:04.852	-43.052	171.322	5.0	4.72	3.61	76.67
1973/01/13	09:06:40.547	-43.203	171.507	15.0	3.85	3.05	68.56
1973/01/30	07:23:46.268	-43.232	171.456	12.5	3.56	2.98	79.52
1983/05/15	01:58:36.826	-43.195	171.710	5.0	4.02	3.22	149.12
1984/06/14	01:49:34.956	-43.077	171.387	10.0	3.85	2.49	126.72
1988/10/17	03:40:35.002	-43.041	171.490	10.0	3.75	2.57	133.09
1989/11/04	13:03:29.629	-43.102	171.705	15.0	2.94	2.07	140.68
1990/06/16	19:40:07.023	-43.162	171.581	15.0	2.48	1.87	151.52
1990/06/19	02:24:12.361	-43.177	171.591	15.0	2.40	1.75	150.05
1990/09/09	05:32:57.074	-43.045	171.777	10.0	2.86	1.88	136.11
1991/09/01	15:39:13.320	-43.078	171.783	5.0	4.40	2.07	132.15
1992/03/30	07:02:51.998	-43.021	171.213	5.0	2.53	1.76	143.19
1992/03/30	08:00:07.404	-43.035	171.214	10.0	3.41	1.92	133.74
1992/04/01	05:55:26.523	-43.000	171.223	10.0	3.57	1.94	134.70

1992/04/01	22:57:39.594	-43.000	171.215	5.0	3.52	1.85	132.93
1992/04/01	23:15:09.969	-43.008	171.195	12.5	3.11	1.85	135.26
1992/04/01	23:54:38.500	-43.008	171.198	12.5	2.74	1.75	140.86
1992/09/11	17:06:05.199	-42.986	171.265	12.5	2.83	1.80	139.18
1994/06/18	05:04:56.633	-43.154	171.500	5.0	3.69	2.38	164.11
1994/06/18	07:03:28.115	-43.170	171.506	5.0	3.74	2.30	165.03
1994/06/18	14:36:59.719	-43.173	171.534	5.0	4.11	2.24	165.06
1994/06/19	13:43:51.621	-43.186	171.449	5.0	3.21	2.04	152.03
1994/06/21	02:18:23.284	-43.198	171.461	5.0	3.13	2.01	160.59
1994/06/21	08:31:40.873	-43.187	171.450	5.0	3.16	2.05	162.19
1994/06/29	05:38:31.768	-43.101	171.451	12.5	3.40	1.96	139.26
1994/07/05	22:30:45.461	-43.187	171.568	12.5	4.99	2.45	136.12
1994/07/08	08:21:31.436	-42.956	171.406	12.5	2.85	1.90	141.92
1994/07/12	02:24:00.842	-43.067	171.422	12.5	2.75	1.80	146.96
1994/07/15	13:14:27.984	-43.075	171.400	15.0	3.06	1.80	146.93
1994/07/28	18:55:45.008	-43.190	171.458	15.0	2.84	1.84	147.11
1994/08/05	21:35:28.250	-42.932	171.392	15.0	4.42	2.21	140.47
1994/08/11	14:33:52.395	-42.832	171.411	12.5	3.76	1.91	141.48
1994/08/23	01:12:05.884	-42.954	171.382	15.0	2.64	1.77	143.47
1994/08/26	20:25:30.164	-42.991	171.467	15.0	2.77	1.77	145.77
1994/08/27	11:46:44.273	-42.977	171.424	15.0	2.36	1.68	148.29
1994/09/15	15:09:41.133	-43.161	171.467	12.5	3.01	1.85	143.20
1994/09/23	10:04:50.820	-43.099	171.493	15.0	4.14	2.37	144.02
1994/10/13	01:22:11.390	-43.000	171.410	15.0	3.70	2.06	141.78
1994/11/30	14:26:02.098	-43.053	171.437	15.0	3.33	1.89	139.88
1995/01/18	08:06:36.289	-43.139	171.485	15.0	4.59	1.99	135.44
1995/01/22	14:38:32.391	-43.008	171.487	7.5	4.37	2.31	139.05
1995/01/31	22:23:41.922	-43.059	171.407	12.5	4.83	1.87	137.18
1995/02/17	21:34:38.500	-42.999	171.369	5.0	3.44	1.89	136.37
1995/02/24	11:35:18.000	-42.973	171.373	15.0	3.06	1.83	137.51
1995/05/29	10:06:42.254	-42.952	171.591	12.5	2.88	1.84	143.27
1995/06/21	00:51:30.236	-42.926	171.590	12.5	2.65	1.79	143.44
1995/10/01	22:39:57.086	-42.992	171.321	5.0	2.91	1.82	140.89
1995/12/26	11:10:25.215	-43.002	171.449	15.0	2.76	1.89	139.84
1996/05/29	10:06:42.480	-42.955	171.607	15.0	3.24	1.89	136.58
1997/11/04	13:55:43.555	-42.983	171.366	15.0	2.46	1.94	148.27
2000/01/19	13:12:39.020	-42.906	171.428	10.0	3.14	2.64	99.10
2003/11/20	05:27:21.150	-42.888	171.661	15.0	2.55	2.22	142.56
Lake Tennyson, New Zealand							
1973/04/22	21:58:40.526	-42.268	172.969	6.8	4.94	3.03	133.09
1973/05/06	08:56:22.610	-42.243	172.994	6.8	2.76	2.06	127.28
1973/05/06	09:50:28.448	-42.231	172.980	6.8	2.70	2.01	126.36

1975/06/01	16:12:30.362	-42.302	172.866	6.8	1.85	1.58	110.22
1978/06/21	15:22:18.311	-42.271	172.931	6.8	2.98	2.39	126.79
1979/08/27	20:14:39.628	-42.250	173.016	9.3	3.81	2.97	132.47
1979/09/12	03:45:22.687	-42.284	172.706	11.8	3.37	2.09	133.00
1984/05/05	05:28:26.079	-42.269	172.792	9.3	3.14	2.29	135.08
1984/05/05	05:33:30.479	-42.264	172.843	11.8	3.00	2.25	141.87
1984/05/05	06:24:49.184	-42.288	172.850	14.3	3.50	2.47	135.31
1984/05/05	14:15:24.819	-42.254	172.801	9.3	3.43	2.25	136.10
1984/08/31	13:14:31.010	-42.251	172.771	6.8	3.49	2.87	116.31
1984/09/14	00:20:46.845	-42.268	172.837	6.8	3.44	2.79	78.99
1986/01/27	16:35:29.284	-42.209	172.803	4.3	4.06	3.13	134.64
1986/08/06	10:18:52.046	-42.268	172.824	6.8	3.27	2.55	123.35
1986/08/09	09:04:29.091	-42.290	172.841	6.8	3.48	2.92	71.60
1987/10/27	03:14:59.289	-42.290	172.782	4.3	2.76	2.36	136.09
1988/08/06	10:48:44.491	-42.220	172.751	6.8	4.64	2.33	138.17
1990/02/09	17:28:55.116	-42.249	172.697	9.3	2.49	1.64	130.30
1990/02/10	03:47:46.761	-42.283	172.652	9.3	3.21	1.67	135.96
1990/02/10	03:54:48.116	-42.242	172.614	9.3	2.45	1.68	134.37
1990/02/10	03:57:28.773	-42.236	172.659	9.3	3.84	2.16	137.85
1990/02/10	04:31:07.533	-42.244	172.720	9.3	3.81	1.71	137.59
1990/02/10	05:56:23.604	-42.243	172.685	9.3	3.36	1.68	135.71
1990/02/10	06:47:33.696	-42.275	172.647	9.3	2.88	1.71	133.89
1990/02/10	08:23:34.274	-42.281	172.656	9.3	3.00	1.78	128.23
1990/02/10	08:52:24.383	-42.255	172.735	9.3	4.35	1.81	136.09
1990/02/10	09:30:20.276	-42.209	172.744	9.3	3.37	1.79	133.46
1990/02/10	09:53:07.253	-42.244	172.739	9.3	3.28	1.78	132.81
1990/02/10	11:14:13.882	-42.256	172.714	9.3	2.53	1.65	133.64
1990/02/10	12:07:51.987	-42.288	172.670	11.8	2.43	1.64	130.63
1990/02/10	12:32:37.374	-42.281	172.655	11.8	4.07	1.74	137.22
1990/02/10	13:03:47.850	-42.276	172.681	9.3	2.79	1.65	134.87
1990/02/10	13:47:38.741	-42.272	172.642	11.8	3.16	1.65	136.01
1990/02/10	15:08:23.518	-42.265	172.672	9.3	3.45	1.79	131.83
1990/02/11	22:22:53.714	-42.241	172.708	11.8	2.85	1.66	135.70
1990/02/12	13:36:25.702	-42.242	172.740	11.8	3.89	1.72	137.55
1990/02/12	20:57:22.503	-42.263	172.700	11.8	4.12	1.76	137.12
1990/02/14	07:55:43.274	-42.229	172.718	9.3	4.20	1.78	136.28
1990/03/10	12:09:29.577	-42.249	172.701	4.3	2.72	1.74	131.35
1990/03/29	10:25:05.702	-42.266	172.695	11.8	2.75	1.76	135.51
1990/04/04	04:30:37.700	-42.228	172.695	14.3	3.50	1.87	132.83
1990/06/28	01:22:16.295	-42.215	172.717	6.8	3.47	1.86	137.79
1990/10/15	18:15:52.026	-42.236	172.725	6.8	2.58	1.66	132.97
1990/10/20	08:58:47.362	-42.226	172.708	9.3	2.28	1.66	130.67

1993/04/20	09:41:07.073	-42.306	172.718	14.3	2.63	1.72	121.42
1996/12/11	09:31:59.745	-42.291	172.655	11.8	2.47	1.70	124.33
1997/02/19	08:00:28.407	-42.284	172.631	9.3	3.26	1.95	132.30
1997/09/03	13:53:16.424	-42.284	172.654	9.3	3.96	1.80	126.32
1997/10/15	01:37:53.444	-42.231	172.612	6.8	3.51	1.95	125.82
1997/12/21	17:11:37.846	-42.229	172.959	11.8	3.24	1.75	125.87
1998/04/11	22:20:25.784	-42.467	172.933	6.8	3.47	2.18	127.84
2002/08/30	08:00:47.331	-42.227	172.733	9.3	2.67	1.85	124.77
Wellington, New Zealand							
1990/11/08	12:29:48.443	-41.035	175.349	37.0	2.80	2.22	137.84
1993/05/25	02:18:40.427	-40.941	175.685	30.6	3.23	2.29	133.54
1994/03/27	13:25:39.272	-41.006	174.851	37.5	2.92	2.55	136.06
1994/12/15	15:13:56.979	-40.786	175.082	35.2	2.78	2.36	124.88
1995/05/17	10:36:34.240	-40.650	175.065	13.7	3.46	2.57	127.56
1995/08/10	19:30:32.701	-40.919	175.826	27.0	3.45	2.32	131.42
1995/08/11	14:24:52.514	-40.918	175.814	27.3	3.00	2.23	133.16
1995/11/17	10:29:01.748	-40.807	175.378	37.2	2.79	2.31	132.96
1996/05/17	10:36:34.385	-40.665	175.069	16.7	3.86	2.72	122.83
2000/03/29	14:30:57.787	-41.022	175.479	25.8	3.21	2.32	133.01
2000/04/04	07:33:20.666	-41.066	175.511	30.5	3.34	2.35	132.98
2000/08/14	14:02:16.236	-40.795	175.215	38.4	3.03	2.41	122.53
2002/10/06	07:05:24.373	-41.069	175.501	30.2	2.89	2.21	136.57
2004/04/02	12:09:03.256	-41.187	175.134	37.8	2.83	2.22	142.00
2004/04/02	12:10:22.342	-41.132	175.087	33.6	3.78	2.63	137.99
2004/05/08	19:31:55.154	-41.169	175.121	37.6	2.92	2.26	139.73
2004/05/08	20:10:20.943	-41.166	175.131	38.4	3.10	2.32	138.12
Rotorua, New Zealand							
1976/10/27	20:57:08.962	-37.878	176.478	3.5	4.77	3.44	43.93
1977/05/31	18:50:54.258	-37.821	176.879	3.5	3.49	2.89	53.62
1979/04/19	18:01:08.762	-37.743	176.896	3.5	4.73	3.32	57.22
1987/03/02	01:35:36.640	-37.956	176.863	3.5	3.00	2.63	100.16
1987/03/02	01:42:35.240	-37.923	176.736	18.5	3.34	2.81	98.26
1987/03/02	01:50:58.775	-37.852	176.798	16.0	3.58	2.99	128.12
1987/03/02	03:27:36.926	-38.079	176.728	3.5	3.26	2.92	92.02
1987/03/02	06:44:29.628	-38.141	176.692	3.5	2.81	2.71	97.00
1987/03/02	06:56:34.520	-38.170	176.735	3.5	4.03	3.52	86.35
1987/03/02	07:55:08.092	-37.906	176.821	3.5	3.57	2.97	89.76
1987/03/11	14:31:30.130	-37.870	176.964	3.5	3.93	3.42	92.80
1992/06/21	17:47:40.063	-37.686	176.817	18.5	4.54	3.68	73.78
1998/04/02	06:35:00.477	-38.274	176.638	3.5	4.78	3.57	124.24
1998/04/02	06:59:04.044	-38.214	176.554	3.5	4.51	3.34	112.71
2004/07/18	03:57:56.359	-37.955	176.495	3.5	4.50	4.21	12.12

2004/07/18	03:58:05.158	-37.973	176.472	3.5	4.53	4.32	146.31
2004/07/18	04:22:21.832	-37.997	176.481	3.5	3.79	3.35	110.55
2004/07/18	06:40:14.987	-37.987	176.498	3.5	3.00	2.75	120.04
2004/07/20	15:09:26.505	-37.980	176.506	3.5	3.24	2.93	115.27
Kileaua, Hawaii							
1964/09/18	10:25:29.849	19.396	-155.112	6.7	1.73	1.39	82.37
1967/09/08	12:22:32.017	19.405	-155.251	15.5	2.93	2.45	141.24
1968/08/01	10:34:37.896	19.334	-155.094	9.7	3.61	2.17	156.14
1968/12/17	02:33:03.929	19.346	-155.205	9.4	3.17	2.02	169.46
1969/02/10	02:24:42.503	19.430	-155.138	1.5	4.21	2.15	140.59
1972/09/05	11:31:33.716	19.334	-155.212	10.7	2.55	1.92	173.49
1974/01/12	16:04:33.896	19.327	-155.122	9.4	2.45	1.84	167.93
1974/05/05	11:37:23.556	19.340	-155.261	15.5	2.46	1.88	170.87
1974/06/19	15:05:42.599	19.355	-155.400	10.9	2.08	1.74	5.28
1974/06/21	06:50:26.529	19.331	-155.214	10.0	2.63	1.98	169.57
1974/08/28	07:49:40.741	19.321	-155.207	10.8	2.47	2.07	177.48
1974/11/30	13:54:25.306	19.338	-155.389	6.6	2.78	2.16	29.29
1974/12/15	20:53:48.134	19.472	-155.602	2.1	1.91	1.78	5.70
1974/12/16	09:17:29.689	19.394	-155.430	9.5	2.16	1.81	22.12
1974/12/31	22:40:48.486	19.325	-155.354	3.1	2.48	1.84	6.39
1975/01/01	11:02:07.611	19.184	-155.344	7.5	2.97	1.94	168.57
1975/01/01	20:46:49.642	19.256	-155.391	9.1	3.06	1.66	176.17
1975/01/02	13:27:44.251	19.253	-155.437	8.5	3.50	2.42	160.50
1975/01/04	06:35:52.202	19.324	-155.130	9.7	2.81	2.33	167.99
1975/01/07	03:47:02.836	19.282	-155.389	9.1	2.51	1.81	174.62
1975/07/08	00:47:43.487	19.490	-155.456	3.7	3.63	1.86	158.96
1975/11/29	13:35:41.251	19.392	-155.089	10.2	2.03	1.78	173.33
1976/04/02	18:14:06.392	19.337	-155.112	10.4	2.99	2.23	174.72
1976/12/18	14:01:00.704	19.349	-155.131	10.2	3.24	1.99	172.59
1977/01/14	23:26:42.282	19.318	-155.132	10.4	2.52	2.12	151.81
1977/06/06	09:42:18.708	19.360	-155.079	10.0	2.44	1.80	164.47
1978/06/23	11:47:58.411	19.318	-155.259	10.9	2.31	1.80	179.68
1978/12/27	10:40:55.829	19.344	-155.207	10.3	2.39	1.89	177.16
1980/03/12	12:57:53.013	19.349	-155.229	2.3	2.09	1.61	179.81
1981/11/10	13:02:56.333	19.330	-155.206	10.7	2.48	1.92	12.41
1982/01/21	21:52:40.681	19.201	-155.591	10.7	2.35	2.03	138.00
1982/01/21	22:29:14.439	19.207	-155.602	14.2	2.59	2.41	121.79
1983/03/21	03:18:39.692	19.372	-155.091	7.5	2.75	2.07	160.61
1983/09/09	16:30:55.044	19.328	-155.126	9.5	2.41	2.03	6.02
1985/02/22	05:48:29.189	19.325	-155.213	9.9	2.08	1.71	178.37
1988/03/02	08:41:56.179	19.322	-155.211	10.6	2.23	2.00	170.83
1988/06/07	10:48:45.439	19.330	-155.169	9.3	1.98	1.62	156.84

1988/07/04	05:38:09.214	19.217	-155.438	10.0	1.79	1.39	177.19
1989/06/26	03:27:04.895	19.362	-155.172	9.8	1.94	1.65	169.61
1990/08/09	02:06:35.715	19.327	-155.115	9.7	1.92	1.59	170.30
1993/01/25	08:14:53.872	19.397	-155.316	6.5	1.66	1.44	178.13
1993/01/26	15:24:08.669	19.207	-155.471	9.8	1.83	1.47	173.44
1993/06/08	12:57:49.193	19.332	-155.218	10.4	1.95	1.66	171.22
1995/10/28	00:22:51.148	19.325	-155.118	10.6	2.22	2.05	159.23
1996/11/24	02:39:24.062	19.322	-155.209	11.1	2.81	2.24	26.28
1997/06/30	15:47:39.083	19.341	-155.075	9.8	2.13	1.67	170.57
1998/05/07	23:15:33.923	19.236	-155.490	8.5	2.41	1.86	167.46
1998/09/29	06:39:12.312	19.340	-155.136	10.0	2.80	1.85	0.89
1999/04/17	00:56:24.853	19.238	-155.487	9.9	1.97	1.68	169.09
2000/04/02	06:18:19.183	19.332	-155.194	10.0	1.93	1.60	173.89
2001/08/11	08:14:17.603	19.194	-155.540	11.5	1.96	1.53	10.12
2001/09/11	00:09:21.642	18.965	-155.288	13.5	1.92	1.65	34.94
2001/09/13	13:11:46.884	19.011	-155.268	12.4	1.88	1.65	18.93
2002/01/18	11:18:14.337	19.350	-155.104	9.7	2.16	1.82	165.53
2002/12/26	00:52:58.951	19.240	-155.523	7.1	2.52	1.46	13.63
2003/08/27	06:24:21.740	19.320	-155.193	10.4	2.01	1.66	173.80
Spitak, Armenia							
1967/01/30	01:20:28.175	41.050	44.268	5.0	4.09	2.72	49.30
1978/06/27	04:45:16.902	41.163	44.004	5.0	4.74	2.83	44.13
1978/08/15	09:04:22.951	41.266	43.979	5.0	3.37	2.41	41.17
1982/01/17	10:27:42.828	41.120	43.938	5.0	4.51	2.83	39.71
1983/12/17	00:14:22.439	41.198	44.000	5.0	3.00	2.49	41.49
1988/12/07	07:45:45.658	41.002	44.244	5.0	3.63	3.17	38.38
1988/12/07	09:34:34.371	40.964	44.135	5.0	2.76	2.19	47.51
1988/12/07	10:56:51.484	40.913	44.246	5.0	4.31	3.27	50.17
1988/12/07	14:10:16.883	41.019	44.255	5.0	3.75	3.35	55.57
1988/12/07	18:05:42.895	40.903	44.153	5.0	3.03	2.45	52.87
1988/12/07	20:07:29.508	40.937	44.203	5.0	3.98	2.35	36.89
1988/12/08	04:09:37.309	40.957	44.103	5.0	4.84	2.66	33.95
1988/12/08	05:36:30.240	40.972	44.048	5.0	3.24	3.14	133.60
1988/12/08	07:46:01.666	40.801	44.371	5.0	3.38	2.65	23.31
1988/12/08	20:32:06.031	40.916	44.222	5.0	3.38	2.73	13.56
1988/12/12	15:36:18.629	40.949	44.278	5.0	3.96	2.70	40.53
1988/12/19	17:29:35.867	40.915	44.325	5.0	4.34	3.10	40.09
1988/12/31	04:07:10.977	40.974	43.991	5.0	3.06	2.85	168.09
1989/01/04	07:29:41.748	40.956	44.265	5.0	2.91	2.48	52.09
1989/01/08	13:09:23.172	40.967	44.131	5.0	4.27	2.53	43.98
1989/01/24	02:31:09.744	40.947	44.269	5.0	4.00	3.42	85.37
1989/03/30	16:36:24.199	41.027	43.903	5.0	2.73	2.53	31.84

1990/05/27	18:27:58.164	40.895	44.260	5.0	2.75	2.41	55.45
1999/01/14	22:45:15.047	41.175	44.028	5.0	3.13	2.74	171.77
Racha, Georgia							
1971/05/16	20:17:32.898	42.542	43.448	5.0	4.16	2.82	76.30
1971/05/18	00:11:55.240	42.530	43.435	5.0	3.86	2.56	76.50
1971/06/28	19:53:43.539	42.591	43.521	5.0	3.65	2.65	73.03
1972/07/30	22:13:45.070	42.524	43.365	5.0	4.16	2.84	61.84
1987/10/23	06:50:35.814	42.526	43.357	5.0	3.34	2.36	35.74
1991/04/29	09:37:38.148	42.375	43.815	5.0	2.83	2.53	21.26
1991/04/29	09:59:25.172	42.447	43.354	5.0	4.20	2.50	14.96
1991/04/29	10:01:14.238	42.384	43.858	5.0	3.89	2.45	13.77
1991/04/29	10:52:42.992	42.482	43.927	5.0	3.95	2.60	30.88
1991/04/29	11:04:30.547	42.419	43.917	5.0	3.97	2.80	86.83
1991/04/29	11:10:13.062	42.389	43.869	5.0	3.79	2.46	11.49
1991/04/29	11:51:11.316	42.394	43.783	5.0	2.59	2.14	23.96
1991/04/29	11:59:55.621	42.362	43.917	5.0	2.62	2.30	34.51
1991/04/29	13:49:59.816	42.432	43.340	5.0	3.09	2.36	47.45
1991/04/29	14:43:07.484	42.364	43.877	5.0	2.30	2.05	39.95
1991/04/29	17:10:28.957	42.390	43.558	5.0	3.78	2.73	76.74
1991/04/29	17:55:00.727	42.434	43.918	5.0	2.97	2.51	89.50
1991/04/29	18:23:16.352	42.405	43.729	5.0	2.32	2.08	49.05
1991/04/29	18:30:41.867	42.437	43.828	5.0	2.23	2.03	55.49
1991/04/29	19:07:04.883	42.390	43.668	5.0	3.51	2.59	18.14
1991/04/29	19:19:56.555	42.414	43.912	5.0	3.34	2.67	87.35
1991/04/29	19:44:55.375	42.422	43.906	5.0	3.01	2.63	100.90
1991/04/29	20:24:43.906	42.326	43.774	5.0	2.92	2.40	19.81
1991/04/29	20:32:55.328	42.403	43.291	5.0	2.25	1.99	56.08
1991/04/29	21:24:10.758	42.496	43.696	5.0	4.96	3.06	5.49
1991/04/29	22:28:23.781	42.401	43.729	5.0	2.51	2.21	48.73
1991/04/29	23:32:30.078	42.354	43.933	5.0	3.89	3.15	29.31
1991/04/30	11:15:30.605	42.424	43.470	5.0	2.56	2.17	36.57
1991/04/30	16:07:40.734	42.493	43.276	5.0	4.26	2.72	23.59
1991/05/01	03:06:52.354	42.387	43.915	5.0	3.50	3.23	1.71
1991/05/01	05:13:36.965	42.518	43.511	5.0	3.29	2.53	12.65
1991/05/01	23:19:12.172	42.404	43.915	5.0	4.59	3.11	99.51
1991/05/02	01:25:30.770	42.387	43.957	5.0	2.77	2.37	16.58
1991/05/02	09:00:35.396	42.410	43.858	5.0	4.50	3.18	92.60
1991/05/02	09:44:43.328	42.485	43.558	5.0	3.24	2.51	15.46
1991/05/03	06:08:38.732	42.441	43.335	5.0	3.16	2.34	43.12
1991/05/03	20:19:40.016	42.543	43.232	5.0	2.18	1.91	61.67
1991/05/03	23:41:03.016	42.511	43.279	5.0	2.18	1.88	60.18
1991/05/06	01:35:28.653	42.510	43.190	5.0	4.19	2.61	39.39

1991/05/06	02:54:25.705	42.366	43.707	5.0	4.85	3.80	67.84
1991/05/10	01:25:17.405	42.497	43.239	5.0	4.82	2.47	12.22
1991/05/10	20:30:44.109	42.499	43.442	5.0	3.08	2.47	35.73
1991/05/10	20:52:28.320	42.345	43.937	5.0	2.66	2.17	27.61
1991/05/14	09:36:26.477	42.497	43.509	5.0	4.20	3.52	85.75
1991/05/15	14:28:50.988	42.462	43.353	5.0	2.32	2.00	55.29
1991/06/17	03:04:47.273	42.321	44.113	5.0	3.28	2.93	110.03
1991/06/21	14:42:23.008	42.288	44.203	5.0	3.91	3.14	120.34
1991/06/30	20:09:20.477	42.440	43.737	5.0	2.55	2.25	44.18
1991/07/04	06:26:31.584	42.303	44.122	5.0	2.23	1.97	55.05
1991/08/06	15:53:12.973	42.367	43.958	5.0	4.77	3.41	58.35
1992/01/27	08:11:34.588	42.282	44.085	5.0	3.85	2.99	36.17
1992/03/27	19:21:03.023	42.375	43.785	5.0	2.52	2.21	57.16
1992/03/27	21:02:55.328	42.423	43.746	5.0	4.29	3.40	80.45
1992/08/21	19:11:06.734	42.437	43.297	5.0	4.01	2.42	12.07
1993/02/22	04:24:22.128	42.453	43.875	5.0	2.56	2.17	32.75
1994/02/11	17:40:08.484	42.411	43.795	5.0	3.80	2.64	56.90
1994/12/12	13:14:05.652	42.563	43.445	5.0	3.16	2.57	50.99
1998/06/08	09:55:18.191	42.429	43.704	5.0	4.26	3.73	167.78
Izmit, Turkey							
1997/02/12	13:57:46.437	40.682	29.989	13.8	3.49	2.32	1.31
1997/10/21	10:49:34.312	40.661	30.414	13.8	2.53	2.00	15.95
1997/10/24	00:11:14.203	40.723	30.129	13.8	2.48	1.85	8.87
1998/11/11	11:33:55.168	40.634	29.991	13.8	2.81	1.87	8.08
1999/07/05	22:30:04.226	40.728	29.840	13.8	3.07	2.17	46.36
1999/08/17	00:16:28.238	40.767	29.830	13.8	4.66	3.32	177.34
1999/08/17	00:44:22.372	40.651	30.671	13.8	4.74	2.93	152.26
1999/08/17	00:57:44.043	40.703	29.727	13.8	4.25	2.65	24.60
1999/08/17	01:07:53.508	40.705	29.970	13.8	2.41	1.80	13.61
1999/08/17	02:34:54.744	40.640	30.618	13.8	4.50	2.58	8.26
1999/08/17	02:42:57.252	40.614	30.581	13.8	2.18	1.58	17.27
1999/08/17	02:50:47.279	40.744	30.072	13.8	2.13	1.56	12.64
1999/08/17	03:08:15.809	40.630	30.653	13.8	4.69	3.65	112.22
1999/08/17	03:14:01.927	40.633	30.678	13.8	2.20	1.59	14.89
1999/08/17	03:23:16.192	40.732	30.220	13.8	2.84	1.94	178.57
1999/08/17	03:43:07.340	40.744	30.318	13.8	3.62	2.16	10.03
1999/08/17	04:20:18.867	40.684	30.392	13.8	2.47	1.63	13.43
1999/08/17	04:39:59.623	40.669	30.356	13.8	3.31	2.04	177.22
1999/08/17	05:10:08.849	40.728	30.041	13.8	2.55	1.75	10.32
1999/08/17	05:45:23.310	40.728	30.016	13.8	2.66	1.74	12.44
1999/08/17	06:01:33.883	40.735	29.904	13.8	4.35	3.60	171.99
1999/08/17	07:21:03.340	40.652	30.582	13.8	3.15	2.23	6.07

1999/08/17	08:09:21.127	40.680	30.660	13.8	3.48	2.98	21.35
1999/08/17	09:31:56.621	40.631	30.109	13.8	4.30	2.97	4.41
1999/08/17	10:46:43.363	40.704	29.689	13.8	3.49	2.58	36.69
1999/08/17	11:36:43.676	40.682	30.600	13.8	4.79	3.97	39.18
1999/08/17	11:58:10.176	40.623	30.514	13.8	2.53	1.68	7.47
1999/08/17	13:10:26.566	40.703	29.575	13.8	3.76	2.21	22.63
1999/08/17	15:17:53.043	40.706	29.747	13.8	3.08	1.66	12.03
1999/08/17	17:09:15.902	40.734	30.227	13.8	3.89	3.32	169.72
1999/08/17	21:14:13.086	40.722	30.691	13.8	3.83	2.51	51.33
1999/08/17	21:47:40.664	40.773	29.977	13.8	4.13	2.90	40.64
1999/08/17	22:12:49.570	40.705	30.567	13.8	2.78	1.93	171.75
1999/08/18	15:34:18.398	40.769	30.021	13.8	3.26	2.66	7.44
1999/08/18	21:15:55.422	40.698	30.636	13.8	3.73	3.24	38.46
1999/08/19	13:04:13.863	40.648	30.598	13.8	2.42	1.71	9.41
1999/08/19	18:34:57.437	40.690	30.552	13.8	3.50	2.83	38.53
1999/08/20	00:03:03.171	40.735	29.787	13.8	2.52	1.65	14.64
1999/08/20	09:48:38.523	40.675	29.733	13.8	3.80	2.74	24.47
1999/08/20	10:00:19.043	40.602	30.635	13.8	2.79	2.13	6.76
1999/08/21	19:21:25.633	40.647	30.434	13.8	4.68	3.73	33.35
1999/08/22	14:31:00.769	40.666	30.734	13.8	2.09	1.63	7.43
1999/08/23	18:07:42.125	40.687	30.486	13.8	4.88	3.54	44.10
1999/08/23	20:35:26.484	40.761	30.619	13.8	3.65	2.69	155.51
1999/08/24	18:58:59.242	40.710	29.980	13.8	3.56	2.76	33.17
1999/08/26	17:49:39.383	40.713	30.045	13.8	3.87	2.19	10.91
1999/08/28	08:27:46.638	40.734	30.063	13.8	3.86	2.89	48.25
1999/08/31	08:10:51.103	40.727	29.979	13.8	1.99	1.51	15.89
1999/08/31	08:33:24.978	40.723	29.962	13.8	2.18	1.66	13.56
1999/09/01	13:57:37.250	40.691	29.953	13.8	4.33	3.51	59.97
1999/09/02	14:25:19.687	40.575	30.673	13.8	3.63	2.09	49.73
1999/09/02	16:29:34.492	40.678	29.692	13.8	3.58	2.65	49.92
1999/09/04	10:30:53.926	40.702	29.959	13.8	3.55	2.61	46.28
1999/09/04	18:27:43.992	40.698	30.283	13.8	4.63	3.35	46.95
1999/09/05	19:52:48.234	40.596	30.564	13.8	3.69	3.06	33.52
1999/09/06	06:33:27.037	40.736	29.708	13.8	3.51	3.03	19.73
1999/09/09	00:43:05.915	40.764	30.792	13.8	3.74	3.38	53.54
1999/09/09	18:58:31.187	40.722	30.613	13.8	4.69	3.15	35.01
1999/09/09	20:21:49.695	40.692	29.924	13.8	3.34	2.55	56.24
1999/09/13	11:55:29.390	40.699	30.098	16.8	1.96	1.48	13.96
1999/09/16	17:58:45.832	40.440	30.230	13.8	4.85	4.51	122.66
1999/09/17	19:50:06.101	40.755	30.151	13.8	2.32	1.99	175.50
1999/09/19	20:26:37.000	40.658	30.502	13.8	2.31	1.97	166.19
1999/09/24	13:44:51.793	40.731	30.216	13.8	3.81	3.24	51.00

1999/10/05	04:10:04.701	40.744	29.833	13.8	3.29	2.59	48.15
1999/11/07	09:06:15.316	40.672	30.013	13.8	4.29	3.70	62.98
1999/11/07	11:15:37.031	40.676	30.069	13.8	4.64	3.48	49.23
1999/11/07	16:54:43.269	40.714	30.706	13.8	2.16	1.71	16.03
1999/11/07	17:06:07.492	40.699	30.672	13.8	2.77	2.60	39.99
1999/11/08	11:59:46.277	40.701	30.640	13.8	3.64	1.98	173.60
1999/11/11	14:41:25.008	40.724	30.243	13.8	1.92	1.54	16.44
1999/11/11	14:55:25.941	40.762	30.268	13.8	2.84	2.08	179.19
1999/11/13	02:53:08.971	40.783	30.196	13.8	4.70	2.82	4.50
1999/11/15	03:15:06.153	40.874	30.869	13.8	4.98	4.24	79.59
1999/12/13	19:13:38.773	40.724	30.769	13.8	2.32	1.94	1.26
1999/12/20	11:46:36.683	40.553	30.456	13.8	3.79	2.44	179.90
1999/12/25	11:28:47.011	40.750	30.829	13.8	4.42	2.36	173.92
1999/12/30	21:36:43.797	40.662	30.405	13.8	3.31	2.18	9.18
2000/01/04	16:26:06.168	40.719	30.701	13.8	3.34	2.29	24.74
2000/01/23	07:24:16.162	40.729	30.758	13.8	2.58	2.21	178.78
2000/02/09	16:41:32.691	40.763	30.016	13.8	3.33	2.84	48.20
2000/03/27	11:02:50.640	40.850	30.803	13.8	2.66	2.48	152.90
2000/04/02	18:57:38.969	40.821	30.273	13.8	2.16	1.68	14.53
2000/07/07	16:23:56.761	40.843	30.798	13.8	4.41	3.76	50.87
2000/08/23	13:41:28.023	40.700	30.757	13.8	2.07	1.64	11.41
2000/09/19	03:58:51.440	40.692	30.467	13.8	3.10	2.65	138.03
2000/11/23	18:26:10.617	40.652	30.414	13.8	2.79	2.10	16.82
2004/05/31	22:50:09.031	40.489	30.610	13.8	4.17	3.37	44.89
Duzce, Turkey							
1979/06/28	21:22:10.088	40.754	31.955	11.6	3.48	2.90	5.63
1998/10/22	23:47:20.713	40.961	31.843	11.6	2.74	2.42	14.96
1999/08/17	09:02:10.560	40.806	31.179	11.6	2.45	2.15	27.38
1999/11/12	17:26:15.310	40.782	31.529	11.6	2.96	2.29	40.58
1999/11/12	17:29:31.076	40.771	31.525	11.6	3.00	2.26	29.13
1999/11/12	18:14:31.986	40.833	31.371	11.6	2.32	2.02	54.85
1999/11/12	19:05:48.173	40.785	31.345	11.6	4.01	2.50	40.25
1999/11/12	19:14:44.830	40.790	31.377	11.6	2.93	2.26	31.15
1999/11/12	19:15:34.595	40.812	31.504	11.6	3.13	2.50	42.53
1999/11/12	20:04:45.228	40.777	31.173	11.6	3.17	2.38	9.95
1999/11/12	20:44:35.252	40.841	31.515	11.6	4.68	4.21	132.75
1999/11/12	20:53:54.220	40.792	31.501	11.6	3.88	2.41	9.24
1999/11/12	21:42:25.900	40.835	31.234	11.6	3.53	2.55	9.47
1999/11/12	22:01:12.845	40.826	31.375	11.6	2.47	2.15	56.20
1999/11/12	22:20:53.673	40.850	31.499	11.6	2.72	2.44	31.27
1999/11/12	22:38:02.767	40.756	31.385	11.6	3.55	2.51	38.90
1999/11/13	00:14:49.391	40.848	31.400	11.6	3.66	3.15	58.22

1999/11/13	03:57:32.733	40.761	31.437	11.6	3.86	2.98	10.07
1999/11/13	04:10:22.320	40.805	31.495	11.6	4.94	2.80	65.23
1999/11/13	08:33:43.804	40.810	31.480	11.6	2.94	2.26	51.25
1999/11/13	08:36:15.482	40.826	31.549	11.6	3.69	2.76	179.02
1999/11/13	10:10:34.681	40.816	31.596	11.6	2.91	2.58	18.36
1999/11/13	11:26:49.131	40.808	31.414	11.6	3.83	3.44	118.59
1999/11/13	13:13:54.439	40.799	31.399	11.6	2.99	2.11	51.53
1999/11/13	15:35:57.947	40.838	31.561	11.6	3.43	2.91	177.04
1999/11/13	17:49:34.549	40.811	31.556	11.6	3.68	3.13	74.83
1999/11/13	18:16:52.119	40.821	31.557	11.6	3.34	2.96	49.00
1999/11/13	18:43:44.056	40.813	31.530	11.6	3.90	2.84	3.94
1999/11/14	11:52:32.045	40.845	31.546	11.6	3.13	2.76	4.67
1999/11/14	22:55:17.111	40.848	31.595	11.6	3.65	3.10	13.19
1999/11/15	06:22:24.283	40.798	31.499	11.6	3.60	2.84	178.90
1999/11/16	17:51:18.088	40.782	31.612	11.6	2.33	2.07	38.50
1999/11/17	00:15:48.777	40.810	31.364	11.6	3.23	2.81	4.21
1999/11/17	03:36:00.268	40.767	31.400	11.6	3.02	2.92	18.74
1999/11/17	08:15:26.076	40.862	31.567	11.6	2.40	2.11	29.55
1999/11/18	18:19:32.056	40.825	31.578	11.6	2.91	2.51	27.84
1999/11/20	08:44:13.222	40.801	31.566	11.6	4.02	3.83	106.87
1999/11/21	22:27:33.103	40.780	31.528	11.6	2.70	2.36	17.33
2000/01/05	14:10:04.138	40.819	31.395	11.6	3.67	2.37	31.37
2000/01/20	10:35:58.619	40.873	31.407	11.6	2.54	2.28	49.62
2000/02/14	06:56:34.453	41.019	31.772	11.6	2.29	2.04	50.99
2001/04/01	01:18:47.257	40.917	31.213	11.6	4.12	2.87	4.95
2001/05/06	03:08:08.331	40.901	31.240	11.6	3.12	2.57	26.99
2001/08/26	00:41:12.932	40.990	31.625	11.6	2.29	2.04	51.01
2004/04/13	21:47:23.994	40.764	31.738	11.6	3.25	2.61	17.54
Adana, Turkey							
1983/11/24	00:14:05.774	37.027	36.286	9.8	3.64	3.19	34.76
1987/12/31	17:26:04.617	36.890	36.143	14.8	4.63	3.64	29.78
1989/06/24	03:09:55.716	36.699	36.083	19.8	3.31	3.03	37.16
1994/02/10	06:15:18.382	36.950	35.951	14.8	3.62	3.23	46.66
1998/06/27	13:55:50.765	36.851	35.472	19.8	3.17	2.96	44.26
1998/06/27	14:15:38.250	36.836	35.753	19.8	3.81	3.53	138.35
1998/06/27	21:49:49.976	36.767	35.511	19.8	4.13	3.55	78.40
1998/06/28	03:59:26.296	36.913	35.596	19.8	3.28	3.03	55.40
1998/06/28	15:20:35.218	36.928	35.612	19.8	3.45	3.19	78.03
1998/07/04	09:24:22.488	36.819	35.449	19.8	3.61	3.03	63.88
1998/07/17	18:15:16.203	36.656	36.169	19.8	4.54	3.56	122.10
1998/08/24	02:00:36.450	36.849	35.484	19.8	3.38	3.18	55.97
1998/09/20	22:56:32.648	36.857	35.499	19.8	3.33	3.13	51.17

1998/12/04	04:59:27.644	36.886	35.649	19.8	4.88	3.31	68.67
1999/01/15	02:04:30.490	37.034	35.872	14.8	3.31	3.23	57.04
2000/05/12	03:01:45.156	36.999	36.272	9.8	3.21	3.03	46.58
2001/01/17	12:09:54.722	36.982	36.311	9.8	3.24	3.11	50.43
2001/06/25	13:28:46.511	37.161	36.350	0.0	3.25	3.05	40.71
2001/08/08	23:36:02.562	36.910	36.266	9.8	4.61	3.49	116.64
2002/03/11	01:19:35.503	36.726	36.073	19.8	3.68	3.42	151.27
Bhuj, India							
2001/01/26	07:32:32.936	23.455	70.110	25.3	3.30	2.18	0.77
2001/01/26	15:11:02.208	23.302	70.142	28.8	3.12	2.21	11.77
2001/01/27	04:36:08.999	23.495	70.422	23.7	3.74	2.46	15.90
2001/01/28	01:02:12.534	23.511	70.576	14.5	2.95	2.07	5.65
2001/01/28	03:26:14.468	23.411	70.120	21.0	4.86	3.11	6.10
2001/01/28	17:15:27.364	23.289	70.039	28.5	3.20	2.44	4.00
2001/01/28	18:03:45.922	23.529	70.555	17.3	3.82	2.76	23.09
2001/01/28	19:42:22.293	23.487	70.129	26.0	3.67	2.72	6.39
2001/01/29	09:38:47.317	23.606	70.507	17.8	3.73	2.46	21.04
2001/01/30	03:16:45.499	23.395	70.225	20.3	3.62	3.05	35.22
2001/01/30	18:19:59.379	23.389	70.381	18.3	3.61	2.35	14.89
2001/01/31	09:42:23.606	23.439	70.504	9.5	2.93	2.06	8.67
2001/02/01	22:20:52.918	23.274	70.301	28.3	3.71	2.67	37.90
2001/02/03	03:04:33.147	23.679	70.503	2.4	2.80	2.04	6.38
2001/02/03	10:06:40.438	23.368	70.152	24.6	3.15	2.36	4.76
2001/02/04	04:50:37.555	23.326	70.193	26.2	3.72	3.42	141.85
2001/02/08	09:33:12.243	23.390	70.512	23.3	3.57	2.59	9.88
2001/02/08	16:54:43.020	23.711	70.491	15.3	3.31	2.35	6.06
2001/02/09	10:07:41.094	23.565	70.104	19.3	2.98	2.29	6.14
2001/02/15	10:04:40.266	23.334	70.384	24.6	2.83	2.08	10.14
2001/02/17	08:27:26.629	23.382	70.511	9.1	3.14	2.22	11.50
2001/02/19	02:11:14.067	23.562	70.202	31.4	3.11	2.13	2.58
2001/02/19	08:24:23.008	23.572	70.186	20.3	3.11	2.15	3.12
2001/03/14	10:42:10.145	23.357	70.290	28.6	3.51	2.66	24.99
2001/04/01	08:56:51.721	23.494	70.541	15.3	3.52	2.58	8.32
2001/08/04	11:24:40.399	23.357	70.365	32.2	3.32	2.32	15.05
2001/09/20	13:34:32.750	23.540	70.383	20.6	3.02	2.38	172.04
2001/10/03	00:48:07.259	23.255	70.117	30.3	4.30	3.02	175.59
2001/12/01	22:03:27.239	23.307	70.154	28.7	3.93	2.80	4.58
2002/03/30	06:17:50.004	23.537	70.419	21.6	3.12	2.40	5.23
2003/08/05	11:08:04.543	23.735	70.493	15.9	3.85	2.39	12.81
Chamoli, India							
1968/01/05	06:42:48.270	30.509	79.236	12.5	3.32	3.23	15.36
1969/06/22	01:33:24.527	30.541	79.361	12.5	2.97	2.55	25.57

1971/01/30	20:15:37.485	30.506	79.178	12.5	3.92	3.48	103.78
1977/04/20	04:21:08.764	30.551	79.319	12.5	3.95	2.92	54.13
1978/01/07	07:23:19.600	30.525	79.389	12.5	4.55	3.48	25.14
1984/11/26	03:35:37.321	30.511	79.157	12.5	4.97	3.42	109.36
1987/06/06	11:02:39.711	30.482	79.168	12.5	4.15	2.54	25.70
1988/06/09	12:11:49.696	30.543	79.166	12.5	3.54	2.13	22.55
1990/12/18	02:40:51.469	30.474	79.220	12.5	2.67	2.32	33.45
1991/10/15	19:10:59.805	30.575	79.232	12.5	4.12	2.69	11.44
1995/11/27	21:44:00.930	30.673	79.172	12.5	3.88	1.98	31.12
1996/01/23	17:34:40.188	30.454	79.408	12.5	3.95	2.49	26.67
1996/03/26	08:30:22.860	30.614	79.070	12.5	3.03	2.08	19.34
1998/05/01	11:57:35.536	30.204	79.449	12.5	3.31	2.41	72.68
1998/11/19	12:41:57.622	30.497	79.225	12.5	4.42	1.94	30.73
1998/11/19	16:34:15.926	30.523	79.226	12.5	2.99	1.91	30.52
1999/03/28	19:36:08.118	30.389	79.368	12.5	2.68	1.97	12.81
1999/03/28	19:47:07.313	30.408	79.351	12.5	2.11	1.75	13.57
1999/03/28	20:11:15.524	30.418	79.387	12.5	4.09	2.16	36.46
1999/03/28	23:04:40.040	30.575	79.287	12.5	3.21	2.11	13.06
1999/03/28	23:20:29.196	30.403	79.350	12.5	2.75	1.89	31.29
1999/03/29	00:22:47.075	30.384	79.399	12.5	3.32	2.44	37.70
1999/03/29	08:49:48.137	30.453	79.269	12.5	2.91	2.10	30.87
1999/03/29	13:21:00.571	30.401	79.332	12.5	2.60	1.90	30.82
1999/03/30	15:51:52.133	30.351	79.389	12.5	3.07	2.15	39.40
1999/03/30	21:02:12.954	30.387	79.361	12.5	2.00	1.72	7.31
1999/03/30	21:20:46.391	30.423	79.379	12.5	3.36	2.01	30.25
1999/03/31	15:52:35.364	30.431	79.400	12.5	3.27	2.08	30.78
1999/04/01	02:48:53.683	30.440	79.370	12.5	3.11	2.15	18.62
1999/04/06	19:37:26.711	30.404	79.340	12.5	1.99	1.72	8.17
1999/04/06	20:46:42.922	30.403	79.350	12.5	2.01	1.74	11.09
1999/04/07	15:49:15.735	30.411	79.393	12.5	2.11	1.81	17.04
1999/04/07	16:23:29.887	30.420	79.353	12.5	2.13	1.85	20.78
1999/04/14	17:24:30.665	30.352	79.371	12.5	2.11	1.84	12.14
1999/04/18	17:16:39.637	30.410	79.366	12.5	2.06	1.74	13.41
1999/04/25	09:52:15.657	30.373	79.395	12.5	3.68	1.99	32.64
1999/05/07	17:12:05.004	30.364	79.393	12.5	3.11	2.32	30.65
2001/03/12	11:34:17.723	30.571	79.123	12.5	3.61	2.13	29.08
2003/05/27	04:23:28.135	30.545	79.286	12.5	2.96	2.12	7.05
Al-Hoceima, Morocco							
1968/04/17	09:12:04.720	35.184	-3.616	5.6	2.81	2.52	121.18
1968/10/30	11:41:55.208	35.167	-3.622	5.6	3.31	2.84	119.88
1970/04/07	09:16:13.431	34.910	-3.784	5.6	3.52	2.78	109.76
1974/02/21	23:51:29.021	35.130	-3.474	5.6	4.15	3.18	34.37

1977/07/15	05:41:50.497	35.155	-3.800	5.6	4.19	3.36	55.18
1981/03/13	05:13:22.659	35.499	-3.754	5.6	4.83	2.98	88.93
1985/12/08	20:14:04.099	35.283	-3.792	5.6	4.97	4.93	139.23
1987/01/02	08:14:50.304	35.383	-3.639	5.6	4.04	2.77	37.94
1987/01/08	23:10:14.161	35.370	-3.611	5.6	3.30	2.67	25.57
1987/12/09	15:40:33.567	35.439	-3.797	5.6	2.65	2.28	7.12
1987/12/10	00:20:26.083	35.434	-3.817	5.6	4.15	3.35	146.42
1987/12/24	00:45:40.427	35.440	-3.850	5.6	4.72	3.98	129.95
1988/04/09	09:50:46.599	35.020	-3.519	5.6	3.70	2.70	25.43
1988/07/24	00:47:23.823	35.427	-3.765	5.6	4.07	3.41	161.63
1988/10/05	00:42:10.558	35.471	-3.880	5.6	3.48	2.55	5.75
1988/10/20	22:51:59.911	35.473	-3.910	5.6	3.80	3.24	21.74
1989/03/08	00:26:05.874	35.068	-4.337	5.6	4.64	4.09	28.00
1989/08/06	04:32:59.519	35.124	-3.543	5.6	3.92	2.91	39.81
1989/08/12	04:12:53.133	35.185	-3.825	5.6	4.59	2.86	36.77
1989/08/22	07:06:38.507	35.226	-3.821	5.6	4.28	3.95	102.02
1989/08/30	08:52:12.565	35.204	-3.854	5.6	3.68	3.57	106.18
1989/09/16	04:18:00.421	35.214	-3.898	5.6	3.85	3.10	167.92
1990/04/18	09:44:30.192	35.319	-4.006	5.6	4.33	2.99	1.82
1990/06/20	08:05:23.769	35.200	-3.809	5.6	3.65	3.45	115.98
1991/07/06	13:34:55.923	35.351	-3.540	5.6	3.72	2.76	178.22
1991/08/21	09:16:56.755	35.439	-3.812	5.6	4.61	3.97	23.57
1993/08/20	21:10:27.044	35.105	-4.240	5.6	4.93	3.44	85.00
1994/05/01	06:31:21.690	35.312	-4.072	5.6	2.78	2.36	118.07
1994/05/26	01:45:17.571	35.282	-4.036	5.6	3.87	3.70	33.91
1994/05/26	08:26:53.360	35.247	-4.077	5.6	2.40	2.08	160.72
1994/05/26	09:25:21.013	35.245	-4.063	5.6	2.62	2.55	111.09
1994/05/26	10:17:03.142	35.265	-4.026	5.6	3.45	2.89	94.60
1994/05/26	12:27:53.814	35.216	-4.044	5.6	2.65	2.42	151.46
1994/05/29	23:45:07.114	35.294	-4.027	5.6	3.07	2.70	103.90
1994/06/01	00:53:52.741	35.207	-4.033	5.6	2.77	2.45	122.46
1994/06/01	02:33:48.421	35.213	-4.047	5.6	2.78	2.48	122.92
1994/06/03	08:57:39.245	35.225	-4.045	5.6	2.56	2.21	155.51
1994/06/04	01:35:34.411	35.221	-3.974	5.6	3.70	3.26	93.39
1994/06/04	08:27:06.589	35.188	-3.988	5.6	4.17	3.42	88.49
1994/06/06	02:06:24.461	35.225	-3.940	5.6	4.08	2.98	96.87
1994/06/06	07:44:43.212	35.297	-3.955	5.6	2.62	2.22	107.55
1994/06/07	15:32:43.013	35.342	-3.991	5.6	3.51	2.50	70.45
1994/06/08	03:08:32.118	35.277	-3.995	5.6	3.11	2.47	92.72
1994/06/09	09:03:03.054	35.450	-3.826	5.6	3.89	2.58	82.61
1994/06/15	00:15:20.809	35.215	-4.006	5.6	2.62	2.28	132.72
1994/06/16	10:20:33.185	35.205	-4.025	5.6	2.80	2.39	129.96

1994/07/01	20:08:49.317	35.175	-4.037	5.6	3.10	2.37	119.69
1994/07/26	06:25:01.315	35.327	-3.953	5.6	3.47	3.00	98.63
1994/07/30	15:37:24.224	35.342	-4.005	5.6	4.70	2.76	72.16
1994/08/10	17:41:57.571	35.314	-3.971	5.6	2.70	2.30	68.26
1994/08/14	02:51:56.688	35.331	-3.966	5.6	3.08	2.93	108.09
1994/08/17	19:26:10.107	35.323	-3.986	5.6	2.82	2.34	59.99
1994/08/20	04:55:27.208	35.238	-4.058	5.6	2.85	2.34	121.69
1994/08/20	12:17:51.618	35.319	-3.990	5.6	2.95	2.42	1.48
1994/08/22	16:39:20.649	35.351	-3.951	5.6	3.97	2.52	72.76
1994/08/27	23:41:37.349	34.957	-3.757	5.6	3.18	2.79	134.29
1994/09/14	02:55:26.883	35.309	-3.994	5.6	4.31	3.84	32.61
1994/09/15	23:23:57.935	35.279	-4.112	5.6	4.08	3.82	24.84
1994/10/07	08:52:43.149	35.214	-4.024	5.6	3.03	2.34	123.18
1995/03/14	10:29:36.130	35.322	-3.997	5.6	3.48	2.45	61.61
1995/03/19	03:41:21.251	35.319	-4.070	5.6	3.74	2.37	65.18
1995/03/22	00:38:11.075	34.910	-4.131	5.6	3.89	2.77	132.77
1995/06/30	03:35:11.681	35.071	-4.152	5.6	3.34	2.51	126.57
1995/10/15	01:43:11.122	35.204	-4.050	5.6	2.71	2.33	111.75
1995/12/23	21:23:59.966	35.291	-4.020	5.6	2.81	2.53	113.05
1996/04/24	19:36:11.685	35.216	-4.025	5.6	2.99	2.20	179.60
1996/06/08	21:16:18.216	35.251	-4.057	5.6	2.37	2.10	142.08
1996/06/09	11:37:04.681	35.100	-4.116	5.6	2.70	2.26	128.19
1996/06/09	17:21:18.728	35.081	-4.087	5.6	3.86	2.87	98.50
1996/09/16	01:38:13.783	34.926	-4.266	5.6	2.55	2.30	176.11
1998/10/20	23:47:06.661	34.901	-3.868	5.6	4.51	3.08	28.44
1999/07/07	17:27:34.567	35.259	-4.149	5.6	3.50	2.54	165.57
1999/07/11	16:03:55.450	35.228	-4.155	5.6	4.06	2.72	160.07
1999/07/18	17:26:47.376	35.230	-4.160	5.6	2.91	2.23	170.61
2004/02/25	05:21:15.263	35.140	-4.034	5.6	2.68	2.31	176.30
2004/02/25	12:44:56.935	35.180	-3.909	5.6	2.63	2.19	179.58
2004/02/26	12:07:04.364	35.226	-4.023	5.6	2.55	2.11	175.89
2004/03/07	06:37:53.321	35.075	-4.002	5.6	2.49	2.07	179.37
2004/03/12	17:21:52.942	34.973	-4.047	5.6	2.43	2.24	168.39
2004/06/20	22:47:07.239	35.055	-3.890	5.6	3.22	2.72	16.59
Aldan River, Russia							
1989/04/21	19:08:37.926	57.091	122.306	24.3	4.45	4.06	22.03
1989/04/24	01:34:01.363	57.070	122.230	24.3	4.36	4.01	35.52
1989/04/29	06:25:40.364	57.091	122.237	23.6	4.29	3.90	35.46
1989/05/07	16:28:06.583	57.013	122.162	21.0	4.34	3.98	33.00
1989/05/17	05:04:37.065	57.019	122.183	24.2	4.30	3.89	34.91
1989/05/17	15:55:24.145	57.042	122.203	26.4	4.77	4.22	21.04
1989/07/09	20:07:47.278	57.039	122.168	27.3	4.43	3.99	29.50

Meckering, Australia							
1976/10/29	06:04:48.971	-31.582	117.017	5.0	4.76	3.73	164.79
1979/07/11	22:14:53.112	-31.658	116.994	5.0	4.60	3.74	168.46
1982/02/20	05:26:24.666	-31.566	117.093	5.0	4.82	3.80	166.45
1986/09/01	13:53:50.053	-31.578	117.056	5.0	4.66	3.90	169.41
1987/03/02	16:44:18.202	-31.571	117.043	5.0	4.62	3.67	169.28
1990/01/17	06:38:09.122	-31.667	117.004	5.0	4.86	3.98	167.82
1996/06/18	13:31:01.850	-31.661	117.046	5.0	4.65	3.71	169.67
1996/06/21	14:57:00.190	-31.608	117.052	5.0	4.63	3.70	169.18
2003/03/24	11:50:32.752	-31.669	117.071	5.0	4.42	3.47	172.09
Stilfontein, South Africa							
1984/08/11	21:23:14.239	-26.894	26.807	9.1	3.71	2.70	155.36
1985/04/24	02:48:58.595	-26.933	26.761	4.1	2.54	2.38	134.13
1987/04/09	13:31:55.657	-26.926	26.852	9.1	3.31	2.38	152.24
1987/07/30	12:46:30.020	-26.919	26.916	9.1	3.66	2.69	130.28
1987/09/30	07:37:37.848	-26.884	26.780	6.6	3.27	2.63	148.01
1988/09/12	02:32:22.216	-26.895	26.779	4.1	2.40	2.25	31.11
1988/11/28	12:13:08.102	-26.963	26.752	9.1	4.10	2.57	151.17
1988/12/15	14:31:54.114	-26.865	26.851	4.1	4.82	3.51	5.08
1988/12/31	12:50:00.813	-26.893	26.769	4.1	3.32	2.48	0.30
1990/03/15	22:02:41.950	-26.864	26.857	6.6	4.63	3.85	22.02
1990/07/27	17:46:25.794	-26.825	26.814	4.1	3.67	2.88	122.55
1990/11/15	14:12:27.969	-26.859	26.857	6.6	3.08	2.77	150.07
1991/06/10	13:28:06.196	-26.913	26.815	4.1	3.61	2.42	152.57
1991/06/14	14:15:43.262	-26.893	26.713	4.1	3.30	2.97	142.69
1991/06/29	05:27:37.846	-26.918	26.818	6.6	3.27	2.38	150.01
1991/07/12	13:29:48.391	-26.923	26.713	4.1	2.50	2.27	113.92
1991/07/17	11:48:11.809	-26.853	26.886	9.1	3.19	2.39	154.39
1991/07/23	01:02:30.528	-26.832	26.872	9.1	3.57	3.36	176.79
1991/09/10	17:46:42.505	-26.942	26.753	4.1	4.86	3.82	151.21
1991/09/30	16:54:33.469	-26.873	26.698	4.1	3.44	2.81	143.06
1991/12/24	02:16:52.688	-26.976	26.768	4.1	4.58	3.41	155.77
1991/12/24	02:26:21.105	-26.929	26.755	4.1	4.10	3.17	157.84
1992/01/18	23:29:07.942	-26.937	26.825	6.6	4.37	3.77	122.52
1992/02/26	16:56:01.438	-26.861	26.717	4.1	4.54	3.21	117.57
1992/05/01	12:49:06.036	-26.937	26.834	6.6	3.16	2.47	122.70
1992/06/05	15:11:30.317	-26.883	26.801	9.1	3.97	2.97	147.93
1992/06/19	07:26:09.618	-26.950	26.806	4.1	3.04	2.49	114.31
1992/06/23	06:13:19.807	-26.935	26.715	4.1	4.99	2.99	112.45
1992/06/25	15:25:25.009	-26.908	26.869	4.1	3.68	3.27	149.23
1992/07/18	15:40:21.012	-26.875	26.821	6.6	3.22	2.54	157.85
1992/09/01	15:51:23.028	-26.913	26.784	6.6	3.48	2.79	3.68

1992/09/29	00:15:02.768	-26.864	26.808	4.1	4.89	2.47	163.31
1993/01/30	08:46:47.768	-26.798	26.852	9.1	3.32	2.54	163.59
1993/02/20	09:47:27.216	-26.849	26.829	9.1	4.23	3.54	160.01
1993/02/23	13:11:15.485	-26.846	26.712	4.1	3.85	2.40	134.30
1993/03/11	01:48:32.683	-26.859	26.843	6.6	3.01	2.39	111.62
1993/04/28	12:52:15.786	-26.915	26.820	4.1	2.86	2.53	168.57
1993/05/11	03:57:45.115	-26.849	26.897	9.1	3.69	2.93	164.37
1993/05/19	04:09:09.582	-26.854	26.827	6.6	3.32	2.94	168.93
1993/06/02	05:57:00.219	-26.855	26.833	9.1	2.90	2.45	125.12
1993/07/10	10:08:06.372	-26.904	26.816	6.6	3.38	3.12	165.49
1993/08/18	09:02:12.288	-26.884	26.817	6.6	3.49	2.72	158.81
1993/11/09	17:54:03.427	-26.731	26.863	11.6	3.84	2.91	126.80
1993/12/09	05:01:29.325	-26.855	26.829	9.1	4.17	3.50	161.99
1993/12/20	20:22:35.520	-26.929	26.799	4.1	2.67	2.19	0.24
1994/02/25	07:59:19.032	-26.835	26.777	6.6	4.13	3.98	141.17
1994/04/18	07:56:19.178	-26.816	26.696	4.1	2.84	1.82	141.39
1994/06/12	01:42:14.169	-26.904	26.814	6.6	3.46	1.97	139.13
1994/07/27	14:39:08.766	-26.890	26.788	4.1	3.64	1.78	126.43
1994/07/31	06:21:15.469	-26.881	26.830	4.1	4.16	1.89	124.84
1994/09/06	04:04:42.576	-26.825	26.797	4.1	3.84	2.62	160.13
1994/09/21	13:36:49.165	-26.900	26.785	4.1	2.63	1.74	138.08
1994/10/09	11:43:26.333	-26.912	26.804	4.1	3.32	2.02	143.31
1995/06/06	00:29:50.511	-26.845	26.850	11.6	3.13	1.89	140.22
1995/09/24	20:23:22.583	-26.861	26.759	4.1	4.49	1.90	124.46
1995/11/10	23:55:06.177	-26.912	26.872	4.1	3.93	1.82	113.50
1996/04/05	04:02:01.026	-26.925	26.783	4.1	2.11	1.88	73.83
1996/06/16	12:13:36.844	-26.911	26.741	4.1	3.15	1.75	115.21
1996/09/05	13:32:41.637	-26.945	26.718	4.1	4.97	1.91	124.58
1996/09/07	09:11:09.766	-26.957	26.764	4.1	2.03	1.74	119.01
1997/02/10	16:10:30.427	-26.902	26.778	4.1	1.84	1.66	142.01
1998/09/25	15:51:31.895	-26.932	26.838	4.1	1.93	1.73	118.80
1998/11/18	16:30:06.040	-26.950	26.823	4.1	1.97	1.75	120.63
1999/10/11	14:24:20.802	-26.894	26.773	4.1	2.42	1.90	97.28
2000/06/25	13:59:05.423	-26.916	26.772	4.1	2.16	1.84	100.40
2000/09/17	14:10:02.567	-26.955	26.792	4.1	1.83	1.75	139.33
2001/06/14	13:43:08.149	-26.885	26.896	4.1	2.25	1.87	105.21
2001/08/14	01:52:44.953	-26.873	26.670	4.1	4.95	1.91	99.14
2002/02/23	03:28:47.135	-26.962	26.820	4.1	2.43	1.77	106.78
2002/03/23	00:52:08.377	-26.921	26.792	4.1	2.33	1.82	105.82
2002/05/27	16:22:37.364	-26.963	26.782	4.1	2.07	1.80	109.83
Johannesburg, South Africa							
1971/10/30	01:17:44.390	-26.214	28.269	10.0	3.48	2.05	69.92

1972/08/04	20:02:42.953	-26.261	28.088	7.5	4.14	2.13	83.89
1973/04/19	14:13:21.570	-26.209	28.178	12.5	4.08	2.23	77.84
1973/06/10	01:01:16.028	-26.217	28.235	10.0	3.42	2.10	76.66
1973/07/24	08:18:38.396	-26.242	28.069	5.0	4.67	2.30	86.01
1973/10/12	00:13:53.536	-26.219	28.253	12.5	4.32	2.39	72.11
1973/10/24	11:27:16.250	-26.195	28.183	10.0	3.58	2.18	80.74
1973/10/26	12:23:36.211	-26.239	28.108	7.5	3.03	2.00	85.68
1974/01/21	15:15:53.547	-26.156	28.176	12.5	3.25	2.13	83.11
1974/07/15	16:57:38.051	-26.242	28.123	5.0	3.93	2.77	82.77
1975/06/26	10:30:24.789	-26.212	28.120	7.5	4.90	2.03	74.58
1975/08/31	05:52:45.641	-26.182	28.091	5.0	3.95	2.16	91.26
1976/04/26	11:21:42.574	-26.227	28.174	5.0	4.18	2.47	84.42
1976/05/19	05:15:57.143	-26.222	28.195	7.5	4.57	2.50	79.54
1978/05/02	16:57:31.812	-26.197	28.439	12.5	4.22	2.45	58.91
1978/12/03	21:27:06.867	-26.217	28.167	7.5	4.02	2.48	68.36
1979/01/08	22:02:18.906	-26.247	28.193	5.0	3.17	2.01	82.74
1981/04/28	14:36:06.117	-26.236	28.223	12.5	2.88	2.02	72.84
1981/05/27	13:59:10.344	-26.200	28.237	12.5	2.77	1.84	67.32
1981/06/14	12:21:39.582	-26.198	28.168	5.0	3.38	2.07	78.50
1981/06/20	16:23:28.082	-26.227	28.254	10.0	3.53	1.89	62.14
1981/07/18	11:36:26.938	-26.259	28.190	7.5	4.98	2.22	108.04
1981/08/13	12:15:43.563	-26.231	28.175	5.0	3.02	2.15	82.50
1981/08/15	13:34:36.367	-26.234	28.219	5.0	3.10	1.94	69.66
1981/11/06	13:46:06.305	-26.219	28.168	7.5	3.72	2.33	77.73
1982/02/17	18:11:25.504	-26.201	28.235	12.5	2.90	2.01	78.97
1982/03/07	17:17:47.086	-26.229	28.225	12.5	3.05	2.07	75.72
1982/07/04	14:11:37.660	-26.191	28.279	12.5	4.70	2.21	65.70
1982/07/26	19:10:22.375	-26.214	28.179	10.0	3.11	2.02	80.87
1982/08/19	14:06:14.203	-26.200	28.233	12.5	3.06	2.01	74.22
1982/10/02	02:49:28.921	-26.228	28.194	5.0	2.86	1.98	97.98
1983/04/25	11:25:11.227	-26.263	28.208	5.0	2.41	1.75	94.18
1983/06/27	14:31:48.426	-26.241	28.183	7.5	2.65	1.86	90.14
1984/03/07	14:05:30.965	-26.259	28.195	10.0	4.00	2.20	76.13
1984/06/11	11:46:22.199	-26.227	28.154	7.5	2.46	1.75	85.28
1984/11/21	20:28:12.563	-26.235	28.243	12.5	3.08	1.98	88.84
1984/12/08	19:06:35.945	-26.246	28.199	12.5	3.22	2.24	87.31
1985/06/04	14:11:09.570	-26.231	28.172	5.0	3.06	2.07	101.73
1985/06/21	17:38:31.086	-26.226	28.207	10.0	2.62	1.80	91.43
1985/07/22	13:00:28.137	-26.215	28.157	5.0	2.90	1.86	97.00
1985/09/20	14:30:05.449	-26.243	28.218	10.0	3.01	1.94	94.91
1986/07/03	15:10:49.168	-26.224	28.125	7.5	2.83	1.84	100.06
1986/07/15	05:40:35.160	-26.246	28.211	5.0	2.76	1.97	95.43

1987/05/01	19:15:27.578	-26.223	28.151	7.5	3.11	2.23	95.92
1987/09/02	21:02:31.680	-26.223	28.346	10.0	3.32	2.22	72.36
1987/12/29	04:09:51.170	-26.248	28.273	12.5	2.94	2.10	81.86
1995/05/27	11:02:02.352	-26.239	28.246	7.5	4.70	4.19	149.93
1995/08/30	11:11:39.891	-26.245	28.228	5.0	3.75	1.93	106.46
Dowling, Mexico							
1981/07/24	11:38:50.082	32.049	-116.291	15.0	4.08	2.80	135.41
1984/12/09	08:03:11.162	31.961	-116.346	12.8	3.28	2.58	160.95
1985/05/08	23:40:21.188	31.899	-115.859	10.0	3.01	2.34	178.65
1986/02/28	15:28:42.649	31.890	-115.778	2.3	3.02	2.49	5.23
1988/08/31	16:45:17.344	31.823	-115.791	10.0	2.81	2.18	15.24
1990/10/13	03:56:18.606	31.749	-115.922	13.2	2.95	2.17	12.77
1991/03/31	05:29:22.858	32.053	-115.631	5.0	3.25	2.50	23.92
1991/09/02	16:35:55.414	31.805	-115.669	6.2	2.84	2.14	14.12
1991/10/12	08:33:18.873	31.950	-115.836	3.1	2.90	2.16	14.48
1991/12/03	17:54:36.293	31.767	-115.826	4.2	2.85	2.17	14.86
1992/11/20	04:20:34.867	32.088	-116.145	14.7	3.11	2.22	12.39
1994/03/23	02:59:15.960	31.840	-116.125	15.0	3.65	2.39	0.85
Hidalgo, Mexico							
1978/03/12	18:42:24.242	32.341	-115.137	5.0	4.31	4.09	69.59
1978/05/05	21:03:13.945	32.208	-115.318	5.0	3.84	3.09	176.50
1980/06/09	03:28:19.288	32.278	-115.091	5.0	3.88	3.43	164.07
1986/06/23	23:46:08.039	32.198	-115.063	5.0	4.57	3.86	150.31
1986/06/24	13:13:02.227	32.205	-115.090	5.0	3.59	2.93	141.40
1987/02/07	03:45:13.911	32.414	-115.321	5.0	3.51	2.93	166.68
1992/07/27	20:40:07.953	32.668	-115.586	5.0	4.22	3.10	144.40
1993/06/12	05:21:44.535	32.446	-115.260	5.0	3.78	3.01	142.03
1993/09/07	11:24:26.328	32.481	-115.347	5.0	4.94	3.16	143.42
1993/10/11	18:59:45.047	32.491	-115.129	5.0	4.46	3.65	95.22
1993/10/12	01:41:01.438	32.465	-115.090	5.0	3.93	3.03	124.80
1993/10/13	00:39:01.488	32.434	-115.073	12.5	4.05	3.29	148.60
1993/12/08	02:49:39.029	32.458	-115.358	5.0	3.39	2.61	136.38
1993/12/09	00:07:00.555	32.469	-115.368	5.0	3.66	2.80	139.10
1993/12/18	15:44:44.332	32.454	-115.370	5.0	4.06	3.16	157.12
1993/12/20	17:37:02.586	32.458	-115.346	12.5	3.98	3.08	147.14
1999/06/01	15:18:00.656	32.313	-115.268	5.0	3.60	3.41	60.66
1999/09/10	13:40:02.246	32.377	-115.298	5.0	3.96	3.61	67.88
2000/05/02	06:45:44.789	32.198	-115.096	5.0	3.47	3.26	34.74
2002/02/22	19:32:41.070	32.369	-115.365	5.0	3.15	3.09	86.77
Monchique, Portugal							
1996/07/08	16:03:32.243	37.346	-8.821	11.3	2.87	2.50	43.23
1998/03/04	13:08:19.181	37.350	-8.546	11.3	2.77	2.44	38.12

1998/06/08	15:06:34.513	37.340	-8.551	11.3	2.81	2.48	35.81
1998/11/12	17:18:31.161	37.332	-8.433	11.3	2.79	2.45	35.04
1999/09/06	13:33:06.607	37.318	-8.550	11.3	2.84	2.48	33.43
2000/03/31	00:55:17.124	37.319	-8.530	11.3	2.76	2.41	36.75
Cheneville, Canada							
1983/07/17	22:47:45.906	46.047	-74.955	15.5	2.74	2.51	66.26
1992/06/03	04:40:03.674	46.255	-74.994	15.5	2.33	2.30	116.78
1992/11/17	03:58:01.588	45.776	-74.900	15.5	2.75	2.31	149.99
1993/03/17	09:05:41.949	46.085	-75.317	15.5	2.92	2.62	68.40
1993/09/23	06:45:29.014	46.062	-74.576	15.5	2.63	2.48	154.00
1995/02/15	15:53:57.992	45.907	-75.039	15.5	2.76	2.59	150.68
1995/07/28	05:47:37.785	46.173	-74.934	18.0	2.54	2.45	92.15
1995/10/09	05:39:38.147	46.136	-75.245	15.5	2.38	2.28	120.31
1996/02/20	06:13:17.971	45.950	-74.791	15.5	2.48	2.27	124.11
1998/06/17	20:06:55.352	45.966	-74.898	15.5	2.70	2.46	2.87
1998/07/30	08:57:22.852	46.196	-74.685	18.0	2.35	2.21	142.46
1999/03/25	14:06:08.528	45.970	-74.869	15.5	3.00	2.68	154.06
2000/08/06	08:52:24.666	46.205	-74.950	15.5	2.39	2.21	140.24
2001/01/14	11:03:47.727	45.953	-74.972	15.5	2.54	2.25	143.14
2001/02/06	14:44:48.012	46.055	-75.008	15.5	2.61	2.38	150.09
2001/02/14	05:29:48.151	46.078	-74.857	15.5	2.63	2.50	138.11
2001/07/27	13:57:28.699	45.952	-74.811	15.5	2.41	2.36	154.66
2001/07/28	11:22:29.410	45.960	-74.855	15.5	2.95	2.51	146.52
2002/04/01	08:17:09.612	46.151	-75.155	15.5	2.83	2.56	134.50
2002/05/03	17:07:53.539	46.105	-75.027	15.5	3.05	2.66	125.35
2002/06/12	10:29:28.043	45.841	-74.925	15.5	3.05	2.68	138.87
Charlevoix, Canada							
1982/12/04	16:08:32.049	47.592	-70.296	18.6	2.71	2.58	134.08
1983/05/16	02:01:57.588	47.728	-69.950	13.6	2.71	2.16	144.46
1983/06/02	06:30:22.922	47.453	-70.240	8.6	3.15	2.73	48.08
1985/04/10	05:52:56.569	47.585	-69.927	3.6	3.61	3.02	157.75
1986/01/11	13:30:28.327	47.714	-70.159	6.1	2.52	2.23	137.12
1986/08/18	12:28:40.897	47.550	-70.004	3.6	2.59	2.31	123.63
1986/09/19	15:53:02.374	47.351	-70.377	21.1	2.65	2.19	154.92
1987/08/06	20:41:06.475	47.432	-70.282	16.1	3.26	2.65	29.25
1988/01/24	04:33:35.174	47.441	-70.495	3.6	2.74	2.24	161.92
1990/03/13	19:10:40.241	47.559	-70.170	18.6	3.00	2.43	20.37
1990/10/21	13:38:44.088	47.432	-70.389	18.6	3.80	3.01	26.64
1990/11/06	11:30:11.764	47.433	-70.194	18.6	2.62	2.41	16.76
1992/05/01	00:37:51.314	47.495	-70.405	8.6	3.20	2.83	28.87
1993/08/07	21:25:31.014	47.669	-69.886	11.1	3.17	2.39	133.16
1993/12/01	12:47:16.600	47.496	-70.158	16.1	4.31	2.97	11.37

1993/12/30	23:01:47.225	47.457	-70.382	8.6	2.45	1.99	129.53
1996/05/12	11:53:22.268	47.519	-70.029	11.1	2.44	1.87	130.30
1996/06/07	09:41:43.045	47.533	-69.948	11.1	2.59	1.93	129.48
1996/09/24	23:41:03.467	47.564	-70.246	18.6	2.73	2.25	150.93
1997/01/10	19:27:28.350	47.523	-70.196	21.1	2.88	2.19	146.65
1997/08/20	09:12:04.338	47.539	-70.292	6.1	2.37	1.94	135.77
1997/10/28	11:44:18.709	47.670	-69.896	11.1	2.24	1.79	131.02
1998/10/21	07:44:51.694	47.555	-70.275	8.6	2.55	1.92	134.23
1999/09/18	16:09:50.217	47.514	-70.030	11.1	2.32	1.84	132.31
1999/10/02	09:45:36.573	47.415	-70.114	8.6	2.35	1.87	134.70
2000/01/15	04:50:52.993	47.460	-70.279	23.6	3.80	2.49	148.09
2000/06/15	09:25:53.956	47.667	-69.796	13.6	2.70	2.05	131.26
2000/09/21	20:26:38.186	47.492	-69.977	11.1	3.16	2.21	123.41
2000/09/27	12:42:02.124	47.477	-70.029	6.1	2.76	2.11	132.52
2000/12/04	06:44:54.309	47.405	-70.165	8.6	2.45	1.96	131.79
2001/05/22	00:33:28.977	47.650	-69.890	16.1	3.54	2.61	135.23
2001/06/10	15:59:32.291	47.301	-70.209	15.6	2.94	2.15	135.54
2002/01/19	01:18:05.965	47.490	-70.111	13.6	3.78	2.81	138.69
2002/05/14	07:26:39.571	47.644	-69.957	16.1	3.26	2.42	131.60
2002/06/12	17:14:18.342	47.508	-70.020	8.6	2.70	2.12	128.98
2002/06/20	06:10:08.567	47.450	-70.040	6.1	2.62	2.00	134.38
Manzat, France							
1977/04/27	23:25:19.746	46.500	2.942	10.1	3.02	1.84	147.84
1978/07/30	06:35:36.524	45.960	2.774	10.1	2.97	1.86	134.44
1982/11/07	02:01:14.594	46.095	2.804	10.1	2.82	1.94	143.42
1985/01/16	16:15:23.348	46.511	2.933	5.1	1.79	1.65	101.43
1985/01/17	03:11:35.807	46.514	2.942	7.6	1.79	1.65	102.46
1989/05/03	07:44:11.192	46.377	2.452	15.1	1.80	1.71	114.06
1999/01/19	01:29:21.756	45.968	2.817	10.1	1.85	1.66	84.98
1999/12/12	07:41:34.071	46.166	2.741	5.1	2.11	1.73	93.86
2000/07/13	01:50:47.070	45.882	3.027	17.6	1.92	1.73	70.26
2002/03/30	07:22:19.871	46.131	2.790	5.1	1.76	1.63	84.87
2002/08/22	19:24:29.028	46.398	2.582	17.6	1.95	1.80	115.80
2002/08/31	11:33:09.543	46.218	2.797	10.1	2.09	1.79	87.30
2003/02/01	07:13:17.481	46.202	2.535	12.6	1.96	1.79	97.61
2003/02/07	03:45:40.318	46.009	2.904	5.1	1.22	1.09	72.51
2003/07/04	08:22:59.991	46.196	3.011	7.6	2.27	1.76	106.64
2003/07/27	02:55:35.200	46.080	3.074	7.6	1.89	1.59	85.63
2003/08/19	02:57:24.748	45.971	2.810	5.1	1.76	1.62	88.96
2003/08/19	05:30:46.313	45.965	2.807	5.1	1.73	1.59	75.09
2003/08/19	17:12:52.926	45.967	2.815	7.6	1.76	1.64	90.49
2003/08/19	18:22:13.387	45.969	2.811	5.1	1.74	1.62	79.78

2003/08/19	19:53:39.825	45.970	2.807	7.6	1.70	1.59	84.75
2003/08/19	21:55:00.364	45.969	2.816	10.1	1.25	1.14	71.17
2003/08/23	00:28:58.116	45.966	2.813	7.6	1.68	1.57	86.87
2003/09/03	04:07:26.383	45.974	2.800	5.1	2.05	1.81	77.77
2003/09/10	20:18:14.778	45.970	2.808	7.6	1.72	1.58	82.39
2003/11/14	21:49:38.528	45.963	2.810	5.1	1.81	1.63	92.54
2004/06/06	08:43:08.606	45.965	2.839	10.1	1.77	1.67	65.29
2004/06/07	02:36:39.377	45.970	2.830	10.1	1.82	1.69	80.16
2004/09/07	19:02:59.700	45.971	2.812	5.1	1.86	1.73	90.38
Wadgassen, Germany							
2000/01/02	07:25:56.492	49.137	6.850	10.0	1.90	1.62	79.66
2000/01/13	03:25:01.288	49.142	6.844	10.0	1.78	1.54	90.68
2000/01/18	05:51:31.883	49.143	6.844	10.0	1.76	1.55	85.67
2000/01/20	09:34:34.219	49.126	6.801	10.0	1.72	1.53	87.54
2000/01/20	14:26:49.508	49.131	6.868	10.0	1.91	1.71	84.50
2000/01/20	20:05:05.430	49.142	6.845	10.0	1.86	1.56	84.06
2000/02/01	20:29:19.953	49.145	6.842	10.0	1.75	1.55	83.04
2000/02/10	19:32:30.164	49.142	6.842	10.0	1.69	1.48	83.13
2000/02/11	04:34:24.605	49.137	6.835	10.0	1.82	1.56	79.31
2000/02/18	23:29:16.672	49.146	6.850	10.0	1.65	1.45	84.34
2000/02/25	23:52:21.133	49.136	6.849	10.0	1.80	1.52	80.95
2000/03/28	00:17:18.898	49.145	6.840	10.0	1.84	1.52	80.13
2000/04/07	02:00:52.337	49.144	6.852	10.0	1.71	1.58	76.40
2000/04/13	16:06:59.184	49.138	6.857	10.0	1.69	1.49	86.48
2000/04/30	00:22:58.742	49.147	6.847	10.0	1.67	1.47	89.97
2000/06/14	02:25:20.450	49.194	6.588	10.0	1.61	1.47	86.83
2000/06/24	20:53:52.227	49.138	6.829	10.0	2.24	1.71	73.48
2000/07/01	02:54:00.264	49.143	6.847	10.0	1.60	1.47	92.28
2000/08/20	12:29:37.656	49.151	6.852	10.0	1.78	1.54	77.64
2000/08/30	23:36:50.141	49.147	6.849	10.0	1.68	1.48	84.34
2000/09/07	10:28:54.172	49.146	6.847	10.0	3.15	1.95	70.52
2000/10/11	14:44:39.520	49.149	6.850	10.0	1.69	1.51	98.64
2000/10/24	03:54:14.455	49.148	6.864	10.0	2.65	2.06	69.11
2001/01/06	03:31:23.749	49.147	6.842	10.0	1.81	1.57	85.65
2001/01/19	22:56:36.367	49.143	6.845	10.0	1.65	1.51	78.00
2001/03/08	09:07:48.648	49.131	6.849	10.0	1.65	1.50	86.04
2001/03/16	10:13:54.301	49.127	6.845	10.0	1.66	1.50	91.86
2001/03/26	19:34:58.937	49.141	6.845	10.0	1.59	1.42	86.62
2001/04/29	17:23:31.027	49.138	6.842	10.0	1.69	1.59	72.09
2001/05/13	19:12:03.523	49.144	6.891	10.0	2.11	1.68	85.49
2001/05/15	22:43:25.008	49.142	6.857	10.0	1.68	1.48	87.64
2001/05/23	16:45:18.566	49.146	6.856	10.0	1.65	1.46	90.88

2001/06/02	06:58:41.385	49.140	6.854	10.0	1.71	1.51	81.45
2001/06/19	21:19:57.062	49.134	6.824	10.0	2.60	1.96	69.56
2001/06/20	03:16:36.722	49.135	6.833	10.0	2.24	1.78	81.68
2001/06/21	19:38:45.719	49.138	6.849	10.0	2.58	1.83	67.57
2001/06/21	19:55:48.852	49.141	6.860	10.0	1.63	1.45	89.36
2001/07/04	12:10:22.500	49.149	6.844	10.0	1.87	1.54	84.33
2002/02/09	16:15:40.551	49.188	6.973	10.0	1.86	1.64	85.67
2002/04/23	06:44:39.521	49.142	6.851	10.0	1.87	1.59	94.34
2002/08/24	20:48:43.438	49.135	6.848	10.0	1.85	1.49	90.48
2002/09/19	20:20:04.141	49.124	6.871	10.0	1.79	1.65	112.46
2002/09/27	22:36:18.195	49.141	6.851	10.0	1.75	1.57	96.45
2002/11/01	00:20:09.268	49.139	6.843	10.0	1.67	1.56	71.73
2002/11/13	18:07:19.961	49.138	6.848	10.0	1.66	1.49	91.50
2002/12/02	10:24:59.277	49.142	6.845	10.0	1.69	1.49	90.92
2002/12/16	21:33:54.031	49.136	6.874	10.0	2.12	1.57	99.13
2002/12/27	02:43:22.727	49.145	6.853	10.0	1.67	1.51	97.34
2003/01/01	11:24:09.938	49.142	6.839	10.0	1.70	1.49	94.96
2003/01/19	20:35:05.992	49.138	6.850	10.0	1.66	1.49	97.30
2003/01/23	19:59:36.969	49.138	6.847	10.0	1.72	1.55	106.88
2003/02/15	22:53:47.625	49.141	6.859	10.0	1.70	1.60	93.01
2003/02/28	03:07:43.005	49.146	6.843	10.0	1.61	1.47	86.33
2003/02/28	10:52:34.004	49.142	6.851	10.0	1.68	1.57	92.07
2003/03/02	16:15:08.480	49.140	6.864	10.0	1.66	1.49	93.10
2003/03/12	20:27:09.273	49.129	6.838	10.0	1.85	1.55	95.64
2003/03/17	19:05:53.305	49.144	6.853	10.0	1.73	1.64	73.15
2003/04/07	04:40:22.355	49.143	6.845	10.0	1.72	1.52	102.81
2003/05/19	08:09:00.609	49.142	6.842	10.0	1.64	1.53	100.71
2003/05/29	13:45:49.711	49.140	6.855	10.0	1.62	1.49	94.13
2003/07/30	12:48:55.246	49.147	6.846	10.0	1.72	1.50	94.49
2003/08/09	14:21:51.172	49.130	6.842	10.0	1.65	1.51	95.13
2003/11/06	02:40:56.193	49.146	6.873	10.0	2.21	1.70	79.57
Bernov, Czech Republic							
1985/05/07	11:15:51.042	50.220	12.666	7.5	2.47	1.89	70.93
1985/12/06	12:20:28.651	50.216	12.480	7.5	1.85	1.67	38.82
1985/12/14	05:38:06.290	50.220	12.472	7.5	1.83	1.55	118.97
1985/12/14	05:40:42.620	50.228	12.480	7.5	2.18	1.81	107.91
1985/12/16	14:06:03.499	50.218	12.498	7.5	1.74	1.57	91.13
1985/12/16	14:16:54.530	50.219	12.495	7.5	1.88	1.62	102.86
1985/12/16	18:55:29.296	50.235	12.493	7.5	1.74	1.57	102.26
1985/12/16	21:16:17.460	50.217	12.505	7.5	1.74	1.59	92.74
1985/12/16	23:06:24.452	50.218	12.490	7.5	2.02	1.69	97.22
1985/12/17	01:15:32.602	50.222	12.493	7.5	1.80	1.63	93.93

1985/12/17	05:20:04.477	50.220	12.505	7.5	1.74	1.57	97.90
1985/12/17	11:26:53.417	50.214	12.498	7.5	2.06	1.72	99.60
1985/12/17	21:42:18.374	50.231	12.508	7.5	2.49	2.13	94.48
1985/12/20	16:36:29.792	50.228	12.494	7.5	1.69	1.55	95.43
1985/12/21	00:01:20.695	50.226	12.500	7.5	2.10	1.81	40.93
1985/12/21	02:07:48.373	50.213	12.494	7.5	2.03	1.75	37.14
1985/12/21	10:04:10.596	50.225	12.510	7.5	1.88	1.75	30.77
1985/12/21	10:16:19.909	50.233	12.468	7.5	1.66	1.55	33.68
1985/12/21	12:29:15.464	50.215	12.477	7.5	2.35	2.01	42.36
1985/12/21	16:02:49.276	50.234	12.462	7.5	1.81	1.61	53.51
1985/12/21	17:13:18.542	50.228	12.488	7.5	2.08	1.77	83.50
1985/12/21	18:46:54.303	50.219	12.468	7.5	2.65	2.02	42.52
1985/12/21	18:49:25.249	50.219	12.462	7.5	2.08	1.79	95.69
1985/12/22	04:49:40.227	50.220	12.460	7.5	2.05	1.81	38.92
1985/12/22	09:11:17.706	50.206	12.480	7.5	1.96	1.75	92.18
1985/12/22	17:30:56.842	50.214	12.470	7.5	1.79	1.63	41.78
1985/12/23	03:24:48.714	50.206	12.483	7.5	1.71	1.55	104.84
1985/12/23	04:04:51.780	50.229	12.490	7.5	1.81	1.62	107.95
1985/12/23	04:27:08.370	50.222	12.461	7.5	1.71	1.49	108.18
1985/12/23	12:36:19.725	50.213	12.478	7.5	1.03	0.97	116.68
1985/12/23	13:19:28.749	50.224	12.484	7.5	2.02	1.80	39.10
1985/12/24	00:04:17.773	50.231	12.493	7.5	1.89	1.73	35.20
1985/12/24	00:10:02.553	50.223	12.505	7.5	2.03	1.85	32.72
1985/12/24	04:02:39.272	50.236	12.471	7.5	2.04	1.78	37.99
1985/12/24	12:03:37.444	50.221	12.482	7.5	2.23	2.09	137.49
1985/12/25	14:50:14.038	50.235	12.478	7.5	1.73	1.60	98.02
1985/12/29	15:29:48.444	50.227	12.485	7.5	2.03	1.78	45.67
1985/12/30	21:49:52.827	50.232	12.488	7.5	1.98	1.70	93.81
1985/12/31	01:23:43.079	50.241	12.474	7.5	1.56	1.46	101.78
1986/01/01	03:15:18.555	50.225	12.484	7.5	1.94	1.70	107.72
1986/01/01	23:21:09.296	50.242	12.472	7.5	2.32	1.91	169.54
1986/01/20	23:38:29.733	50.239	12.449	7.5	1.69	1.49	117.97
1986/01/21	02:14:20.685	50.223	12.497	7.5	2.23	2.00	42.53
1986/01/21	05:41:19.983	50.238	12.476	7.5	1.83	1.64	97.06
1986/01/21	20:22:00.342	50.243	12.473	7.5	1.91	1.69	99.87
1986/01/23	02:21:57.803	50.232	12.502	7.5	1.57	1.49	108.40
1987/06/20	22:21:06.124	50.455	12.196	7.5	2.90	2.08	138.66
1991/03/24	14:33:29.710	50.281	12.263	7.5	2.47	1.90	112.35
1991/05/19	03:22:11.786	50.355	12.413	7.5	2.30	2.03	27.19
1997/01/17	22:57:38.000	50.234	12.452	7.5	1.97	1.83	13.50
1997/06/01	05:12:50.553	50.348	12.404	7.5	1.79	1.56	159.42
2000/09/04	00:31:45.285	50.223	12.456	7.5	1.58	1.47	155.48

2000/09/08	11:39:50.452	50.207	12.465	7.5	1.57	1.53	151.49
2000/09/08	18:35:47.796	50.212	12.471	7.5	1.60	1.53	176.01
2000/09/17	09:06:55.721	50.208	12.466	7.5	1.60	1.51	123.08
2000/09/17	15:14:32.760	50.213	12.461	7.5	1.64	1.48	162.28
2000/10/15	16:36:47.608	50.199	12.470	7.5	1.57	1.44	167.38
2000/10/15	19:11:20.600	50.198	12.474	7.5	1.55	1.45	134.50
2000/10/15	19:24:14.116	50.208	12.473	7.5	1.60	1.49	132.04
2000/10/15	19:58:51.000	50.202	12.475	7.5	1.67	1.57	114.61
2000/10/23	21:22:01.374	50.203	12.465	7.5	1.55	1.44	119.33
2000/10/23	21:46:58.030	50.211	12.455	7.5	1.62	1.47	108.61
2000/10/24	01:36:35.392	50.199	12.468	7.5	1.93	1.58	104.91
2000/10/29	05:10:46.850	50.209	12.462	7.5	1.63	1.47	115.16
2000/11/05	01:05:04.363	50.206	12.469	7.5	1.63	1.60	167.32
2000/11/06	21:10:18.616	50.198	12.471	7.5	1.63	1.53	144.14
2000/11/06	22:07:19.288	50.199	12.470	7.5	1.51	1.41	135.81
2000/11/06	22:34:37.007	50.199	12.468	7.5	1.58	1.45	125.14
2000/11/06	22:50:35.788	50.204	12.469	7.5	1.51	1.42	127.28
2000/11/06	23:31:32.436	50.208	12.460	7.5	1.58	1.44	118.78
2000/11/06	23:34:25.061	50.209	12.462	7.5	1.73	1.51	121.07
2000/11/06	23:53:06.592	50.205	12.472	7.5	1.53	1.42	132.94
2001/06/05	00:23:36.415	50.410	12.334	7.5	2.74	2.37	15.99
2001/06/05	06:26:23.477	50.400	12.328	7.5	1.91	1.72	134.75
2001/06/09	21:43:22.881	50.299	12.445	7.5	1.90	1.74	42.75
Cieszyn, Poland							
1974/04/24	06:58:04.157	49.819	18.509	3.5	4.23	3.18	144.81
1974/11/07	02:34:34.215	49.986	18.414	3.5	3.97	2.77	12.34
1981/08/11	23:48:06.514	49.776	18.494	3.5	3.55	2.73	160.74
1981/09/09	07:08:08.578	49.777	18.542	3.5	4.89	3.02	174.37
1982/09/10	02:31:54.946	49.823	18.517	3.5	3.26	2.61	176.48
1982/10/30	14:02:06.600	49.842	18.553	3.5	3.32	2.21	4.76
1983/02/08	21:31:13.936	49.781	18.526	3.5	3.41	2.22	7.27
1983/04/27	11:25:01.389	49.819	18.523	3.5	2.70	2.15	166.37
1984/02/17	10:11:23.569	49.807	18.518	3.5	3.72	2.50	1.27
1988/10/04	01:08:10.923	49.781	18.453	3.5	3.08	2.75	17.30
1992/01/07	14:13:21.764	49.829	18.503	3.5	2.55	2.13	6.35
1992/04/22	05:40:20.948	49.800	18.510	3.5	2.64	1.87	172.56
1993/01/28	04:30:53.462	49.806	18.522	3.5	2.73	1.78	165.66
1993/04/09	21:54:36.014	49.814	18.512	3.5	2.66	1.84	174.22
1994/10/31	22:00:55.170	49.800	18.501	3.5	3.00	1.96	178.45
1995/09/24	11:44:19.315	49.804	18.482	3.5	2.65	1.69	165.95
1995/11/27	19:47:52.186	49.803	18.481	3.5	2.82	1.85	164.47
1996/02/25	02:31:25.802	49.824	18.494	3.5	2.91	1.83	169.97

1997/03/07	22:51:11.608	49.803	18.530	3.5	2.36	1.68	169.16
1997/08/11	01:00:44.702	49.833	18.508	3.5	2.53	1.73	162.50
1997/08/21	22:05:58.350	49.798	18.488	3.5	2.65	1.84	171.72
1997/10/18	08:07:34.920	49.831	18.503	3.5	2.42	1.64	164.77
1999/04/15	19:59:17.616	49.829	18.518	3.5	2.38	1.63	163.74
1999/06/01	14:57:28.229	49.801	18.486	3.5	3.03	1.82	165.25
2000/06/10	22:36:31.780	50.014	18.474	3.5	2.58	1.69	170.17
2000/08/23	22:48:53.225	50.001	18.514	3.5	3.89	1.98	179.83
2000/12/23	03:29:01.981	50.037	18.435	3.5	2.56	1.81	166.87
2001/08/20	01:57:49.503	49.829	18.523	3.5	2.84	1.89	177.79
2001/11/07	05:12:06.502	49.814	18.537	3.5	2.53	1.79	164.87
2002/02/06	01:30:56.137	49.828	18.480	3.5	2.46	1.67	164.97
2002/03/15	11:22:16.311	50.049	18.456	3.5	2.68	1.79	169.83
2002/06/13	01:14:40.849	49.814	18.484	3.5	2.28	1.65	169.20
2002/08/06	01:40:08.878	49.802	18.496	3.5	2.79	1.87	169.05
2002/09/24	21:47:29.764	49.809	18.513	3.5	2.71	1.90	170.28
2002/10/28	05:12:31.028	49.834	18.510	3.5	2.89	1.75	163.86
2003/01/28	21:14:42.670	49.836	18.504	3.5	2.49	1.62	168.56
2003/02/26	14:30:05.744	49.820	18.497	3.5	2.41	1.70	172.32
2003/03/29	15:03:49.725	50.039	18.455	3.5	2.33	1.60	168.31
2003/03/30	23:16:27.428	50.049	18.442	3.5	2.58	1.74	165.90
2003/05/16	14:23:24.948	49.832	18.532	3.5	2.57	1.78	162.65
2003/06/15	22:10:34.147	49.832	18.529	3.5	2.32	1.60	167.16
2003/07/17	22:25:54.662	49.826	18.533	3.5	2.72	1.73	169.54
2003/07/30	06:40:44.756	49.832	18.507	3.5	2.52	1.69	165.89
2003/09/16	03:41:42.899	50.048	18.493	3.5	3.44	2.87	125.08
2004/03/11	03:57:56.956	49.835	18.501	3.5	2.35	1.79	173.87
2004/03/11	15:50:03.893	49.801	18.497	3.5	2.50	1.83	173.39
2004/05/28	00:17:35.864	50.062	18.453	3.5	3.10	1.77	172.75
2004/07/12	04:05:17.657	49.834	18.492	3.5	2.73	1.72	171.23
Simuleue, Sumatra							
2005/10/28	03:07:34.905	2.256	96.297	17.3	2.56	2.17	50.95
2005/10/28	17:23:29.282	2.362	96.204	17.3	2.47	2.09	43.38
2005/11/24	15:44:07.736	2.150	96.214	11.3	2.95	2.43	179.06
2005/12/06	05:40:10.167	2.350	96.209	15.3	2.20	2.13	51.47
2005/12/08	22:43:16.290	2.282	96.289	17.3	2.05	2.02	167.61
2005/12/12	12:36:47.579	2.275	96.265	19.3	2.10	2.05	11.77
2005/12/14	02:51:40.043	2.158	96.460	13.3	2.40	2.38	50.91
2005/12/18	04:23:09.108	2.658	95.779	15.3	1.86	1.54	42.72
2005/12/27	01:54:36.226	2.570	95.793	18.3	2.08	1.76	38.39
2005/12/31	15:05:55.361	2.620	95.856	24.3	2.15	1.90	88.52
2006/01/02	18:36:56.954	2.615	95.843	18.3	2.21	2.01	56.73

2006/01/10	05:55:24.241	2.558	96.164	19.3	2.67	2.24	138.92
2006/01/25	14:28:03.989	2.513	95.937	19.3	1.86	1.80	148.11
2006/01/28	17:31:40.165	2.596	95.884	19.3	1.88	1.71	41.60
2006/01/29	22:01:42.759	2.677	95.718	28.3	2.13	1.93	120.55
2006/01/31	19:15:50.743	2.556	95.998	19.3	1.94	1.88	3.34
2006/01/31	19:24:34.915	2.561	95.987	18.3	2.50	2.12	141.18
2006/02/01	00:11:52.634	2.580	96.002	18.3	1.66	1.63	113.06
2006/02/01	04:58:26.907	2.524	95.928	19.3	2.06	1.98	173.12
2006/02/04	01:56:13.455	2.802	95.351	28.3	2.10	1.73	56.16
2006/02/04	02:01:57.475	2.789	95.383	28.3	2.22	1.96	101.25
2006/02/06	07:05:01.591	2.172	96.406	15.3	1.94	1.74	179.27
2006/02/06	12:40:41.517	2.402	95.952	27.3	1.74	1.65	42.60
2006/02/07	19:24:45.454	2.199	96.253	16.3	1.79	1.56	2.45
2006/02/08	09:08:33.493	2.548	95.824	19.3	1.79	1.70	14.16
2006/02/13	09:32:08.072	2.815	95.388	16.3	2.02	1.80	53.47
2006/02/13	12:05:43.001	2.387	96.214	17.3	2.09	1.98	171.06
2006/02/13	12:18:10.693	2.412	96.219	19.3	1.91	1.78	165.76
2006/02/13	12:29:16.052	2.423	96.210	18.3	2.12	1.99	175.65
2006/02/13	16:23:45.614	2.567	95.875	19.3	2.08	1.93	41.39
2006/02/15	05:14:15.630	2.703	95.898	19.3	1.80	1.73	159.44
2006/02/27	17:20:40.880	2.510	95.957	18.3	1.83	1.81	104.09
Puerto Rico							
1964/08/10	01:10:12.939	19.164	-67.326	25.0	4.99	3.68	39.78
1968/04/13	01:15:31.396	19.101	-66.901	25.0	4.57	3.29	52.77
1974/06/21	06:10:47.697	19.012	-67.039	25.0	4.88	3.42	53.15
1992/11/23	06:31:15.867	18.812	-67.210	25.0	4.29	3.15	55.43
1994/06/25	06:40:17.621	19.151	-66.843	25.0	4.22	3.08	60.27
1995/07/09	18:50:08.391	19.691	-67.214	25.0	4.77	3.24	72.50
1995/10/08	04:53:19.328	19.134	-66.970	25.0	4.28	3.07	58.49
1998/03/25	08:27:02.400	19.331	-67.066	25.0	4.34	3.14	65.48
2000/12/11	18:54:05.797	19.319	-67.079	20.0	4.18	3.09	57.79
2003/12/06	03:33:28.549	19.332	-67.348	25.0	4.19	3.04	60.97
2003/12/06	04:33:11.578	19.311	-67.332	25.0	4.19	3.04	61.37
2003/12/14	07:38:09.479	19.288	-67.334	25.0	4.69	3.41	62.29
2004/05/07	08:50:58.934	19.189	-66.825	25.0	4.78	3.10	57.95
Dorud, Iran							
1999/08/01	19:22:51.188	34.064	48.487	8.0	4.51	2.65	176.15
2006/03/30	16:17:06.602	33.905	48.805	8.0	3.27	2.45	160.30
2006/03/31	01:17:01.116	33.812	48.833	7.0	3.72	2.29	175.76
2006/03/31	01:31:23.854	34.041	48.707	8.0	3.51	2.28	174.42
2006/03/31	02:01:14.714	34.093	48.623	8.0	4.22	3.10	1.60
2006/03/31	02:08:57.641	34.128	48.582	8.0	3.96	2.87	171.42

2006/03/31	02:12:27.399	34.102	48.596	8.0	3.58	2.58	169.14
2006/03/31	02:42:34.764	34.127	48.623	8.0	3.33	2.37	155.73
2006/03/31	02:48:28.844	34.099	48.652	8.0	3.61	2.78	163.78
2006/03/31	02:58:28.591	34.119	48.507	8.0	3.23	2.61	166.69
2006/03/31	05:03:08.596	33.848	48.812	8.0	3.77	2.81	153.92
2006/03/31	05:43:04.469	34.231	48.455	8.0	3.72	3.07	167.24
2006/03/31	06:30:00.910	33.937	48.813	8.0	3.88	2.83	142.02
2006/03/31	09:23:35.289	34.077	48.741	8.0	3.21	2.15	162.05
2006/03/31	09:40:26.070	33.848	48.903	8.0	3.46	2.84	171.94
2006/03/31	11:54:02.922	34.071	48.716	8.0	3.19	2.24	164.04
2006/03/31	15:30:09.500	34.021	48.821	8.0	3.12	2.07	155.78
2006/03/31	16:06:04.305	33.835	48.838	8.0	4.15	3.59	144.43
2006/03/31	17:02:18.828	33.997	48.778	8.0	3.69	2.63	146.79
2006/03/31	20:04:14.633	34.027	48.818	8.0	3.65	2.39	156.20
2006/04/01	01:56:46.848	34.092	48.585	8.0	3.44	2.41	161.47
2006/04/01	05:23:03.137	34.087	48.682	8.0	3.29	2.29	148.33
2006/04/01	06:12:38.641	33.908	48.808	8.0	3.48	2.63	152.56
2006/04/01	08:31:06.641	34.114	48.779	8.0	3.47	2.33	152.40
2006/04/01	09:13:37.590	33.879	48.783	8.0	3.76	2.68	168.54
2006/04/01	09:35:56.375	34.133	48.571	8.0	3.95	3.32	167.40
2006/04/01	10:27:23.805	34.066	48.684	8.0	3.77	2.74	168.93
2006/04/01	11:58:57.895	33.845	48.905	8.0	3.64	2.74	149.21
2006/04/01	12:08:34.070	34.133	48.807	8.0	3.70	2.57	166.47
2006/04/01	13:40:35.539	33.854	48.921	8.0	3.69	2.51	146.19
2006/04/02	14:36:41.492	34.043	48.718	8.0	3.36	2.36	169.06
2006/04/02	19:25:59.992	33.914	48.837	8.0	3.18	2.15	156.75
2006/04/03	02:58:59.760	34.170	48.705	8.0	3.47	2.74	166.21
2006/04/03	06:38:44.936	34.102	48.610	8.0	3.56	2.60	158.92
2006/04/03	23:09:13.203	34.019	48.823	8.0	3.17	2.36	154.00
2006/04/04	01:26:30.858	34.139	48.542	8.0	3.35	2.78	174.24
2006/04/04	05:56:46.936	33.939	48.864	8.0	3.22	2.11	158.32
2006/04/04	21:19:24.734	34.127	48.525	8.0	3.36	2.40	158.42
2006/04/06	00:45:26.333	34.021	48.834	8.0	3.46	2.52	163.77
2006/04/06	11:18:10.738	33.885	48.843	8.0	3.60	2.58	155.71
2006/04/06	15:28:36.293	33.837	48.923	8.0	3.35	2.47	160.94
2006/04/07	04:42:31.201	33.918	48.846	8.0	3.47	2.47	162.12
2006/04/07	15:06:18.375	33.718	48.866	8.0	3.51	2.83	172.83
2006/04/08	09:41:16.969	34.063	48.639	8.0	3.08	2.03	158.65
2006/04/09	21:57:06.250	33.894	48.896	8.0	3.47	2.57	163.20
2006/04/14	00:18:36.715	33.948	48.806	8.0	3.50	2.78	168.91
2006/04/14	08:42:19.037	34.054	48.758	8.0	3.23	2.16	155.51
2006/04/19	18:56:36.781	34.165	48.617	8.0	3.21	2.49	163.10

2006/04/19	23:13:41.070	33.916	48.854	8.0	3.05	2.01	155.69
2006/04/21	08:54:22.666	33.878	48.900	8.0	3.26	2.19	151.46
2006/04/23	02:03:29.997	33.789	48.941	8.0	3.66	2.65	152.58
2006/04/24	00:28:05.676	33.927	48.842	8.0	3.12	2.15	158.50
2006/04/27	13:08:04.469	33.861	48.806	8.0	3.36	2.65	172.69
2006/04/28	14:00:05.555	34.038	48.662	8.0	3.71	2.71	172.51
2006/04/29	16:39:14.172	33.894	48.855	8.0	3.33	2.51	155.48
2006/04/29	18:45:45.781	34.004	48.647	8.0	3.43	2.73	155.24
2006/04/29	21:31:33.484	34.113	48.621	8.0	3.63	3.09	139.36
2006/04/29	23:55:26.953	33.575	48.931	8.0	4.61	4.07	74.70
2006/04/30	18:00:18.000	33.911	48.869	8.0	3.11	2.11	156.87
Chi-Chi, Taiwan							
1999/09/20	18:50:48.645	23.907	120.975	12.6	4.90	2.90	164.86
1999/09/20	20:40:03.778	23.907	121.393	9.5	3.78	2.94	93.24
1999/09/20	20:43:49.223	23.726	121.401	9.5	3.32	3.11	111.43
1999/09/20	21:24:33.989	23.978	120.917	9.5	4.54	4.48	6.15
1999/09/20	21:54:47.716	23.647	120.732	9.5	3.75	2.99	89.97
1999/09/20	23:18:14.645	23.655	120.875	9.5	4.34	3.86	32.84
1999/09/21	00:45:43.254	23.914	121.011	33.5	3.83	2.88	171.57
1999/09/21	07:06:03.638	23.917	121.343	9.5	4.05	3.71	8.08
1999/09/21	15:28:10.161	23.625	120.836	9.5	3.25	2.80	140.39
1999/09/21	17:38:39.321	23.834	121.259	24.7	2.90	2.57	101.56
1999/09/21	22:17:02.302	23.902	121.353	11.5	3.07	2.87	124.49
1999/09/22	00:49:44.835	23.760	121.045	39.6	2.58	2.18	115.55
1999/09/22	02:19:33.318	23.843	121.332	24.3	3.65	3.46	163.86
1999/09/22	12:17:20.739	23.733	120.980	32.7	3.55	2.83	77.17
1999/09/23	12:44:32.618	23.926	121.113	9.5	2.91	2.27	93.31
1999/09/23	21:39:03.255	23.890	121.359	19.6	3.60	3.36	55.47
1999/09/25	08:43:31.647	23.678	120.990	21.9	2.89	2.47	111.79
1999/09/25	21:54:07.755	23.602	120.870	13.5	4.00	3.37	164.09
1999/09/27	11:55:08.290	23.764	121.400	9.5	3.76	2.80	161.76
1999/09/30	19:01:59.223	23.939	120.869	9.5	4.71	3.63	162.86
1999/10/01	12:54:10.524	23.704	120.894	10.6	3.58	2.99	157.77
1999/10/01	17:53:32.774	23.742	120.970	8.6	4.83	3.81	157.28
1999/10/04	12:26:15.391	23.773	120.908	15.9	4.09	3.17	86.88
1999/10/05	12:18:17.262	23.834	120.993	17.2	3.50	2.99	107.83

List of Symbols, Abbreviations, and Acronyms

AFRL	Air Force Research Laboratory
EHB	groomed ISC bulletin (Engdahl, van der Hilst and Buland, 1998)
GT	Ground Truth
HDC	Hypocentroidal Decomposition
IMS	International Monitoring System
IRIS	Incorporated Research Institutions for Seismology
ISC	International Seismological Centre, Thatcham, United Kingdom
RCA	Reciprocal Cluster Analysis

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